EM&V Report for the Duke Energy Small Business Energy Saver Program 2019-2020

Prepared for:

Duke Energy Carolinas and Duke Energy Progress

Submitted by:

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1.1 Program Summary

The Small Business Energy Saver (SBES) program is a direct install program offered to qualifying commercial customers with an average annual demand of 180 kW or less. Participating customers receive an energy assessment at their facility, and subsequently a set of recommended energy efficient measure retrofits. Customers receive information about the proposed measure installation and project costs including utility incentives of up to 80 percent for lighting and refrigeration, and HVAC measures. Once approved, the direct installation is scheduled and completed with minimal disruption to business operations.

The following measures are currently included in the SBES program:

1. Lighting Measures: LED interior and exterior lighting solutions.
2. Refrigeration Measures: lighting, motors, and controls for refrigeration cases.
3. HVAC Measures: HVAC controls, thermostats, and tune-ups

Lime Energy is the current Implementation Contractor that administers the SBES program in the Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) jurisdictions. Lime Energy provides integrated energy audits, equipment procurement, and payment services to participating customers. Measure installation is performed by Lime Energy or a subcontractor of Lime Energy.

1.2 Evaluation Objectives and Program Level Findings

This evaluation provides an independent assessment of program impacts and performance for participation that occurred between 1/1/2019 and 6/30/2020. Guidehouse used an engineering-based approach to calculate program impacts, similar to previous evaluation cycles with some differences pertaining to data collection activities. Due to the ongoing COVID-19 pandemic, Guidehouse replaced the previous onsite field study activities with virtual verification to collect information necessary for impact calculations.

Evaluation objectives include the following:

1. Impact Evaluation:
    a. Verify deemed savings estimates through review of measure assumptions and calculations.
    b. Perform virtual verification of measure installations and collect data for use in an engineering analysis.
    c. Estimate the amount of observed energy and peak demand savings (both summer and winter) by measure via engineering analysis.

2. Net-to-Gross Analysis:
    a. Assess the Net-to-Gross ratio by addressing spillover and free-ridership via customer online surveys.

3. Process Evaluation:
    a. Conduct phone interviews with program management and implementation contractor(s) and to collect data for use in process analysis.

b. Administer customer online surveys to collect data for use in process analysis. Evaluate the strengths and weaknesses of current program processes and customer perceptions, with special consideration for effects of the COVID-19 pandemic.

By performing both impact and process components of the EM&V effort, Guidehouse provides Duke Energy with verified energy and demand impacts, as well as a set of recommendations that are intended to aid Duke Energy with improving or maintaining the satisfaction with program delivery while meeting energy and demand reduction targets in a cost-effective manner. Guidehouse found that Duke Energy is successfully delivering the SBES Program to customers, participant satisfaction is generally favorable, and the reported measure installations are relatively accurate.

For the evaluation period covered by this report, there were a total of 1,964 projects comprised of roughly 21,909 measures installed through the program in the DEC jurisdiction and a total of 1,583 projects with roughly 16,853 measures installed through the program in the DEP jurisdiction. The program-level evaluation findings are presented in Table 1-1 and Figure 1-1 for DEC, and Table 1-2 and Figure 1-2 for DEP.

Guidehouse found the realization rate for gross energy savings to be 92~~100 and 101~~ percent for both DEC and DEP~~, respectively~~, meaning that total verified gross energy savings were found to be 0.92 ~~similar~~ to the claimed savings in the tracking database provided by Duke Energy. Virtual impact assessments found the measure installation rate (ISR) to be 96 percent for both jurisdictions, meaning participants self-reported small differences between the measures indicated in the tracking data and those received or currently operating at their facilities. The adjustment of savings by applying ~~However,~~ the ISR and ~~was offset by the addition of~~ HVAC interactive effects during the engineering analysis, ~~which was~~were the main drivers for the final realization rates for energy. The realization rate for DEC and DEP jurisdictions' gross demand savings ~~however~~ were found to both be 979 percent for summer coincident peak demand and 968 percent for winter coincident peak demand. The addition of coincidence factors and demand interactive factors to demand savings calculations were~~is~~ the main drivers of the ~~slightly~~ lowered realization rate.

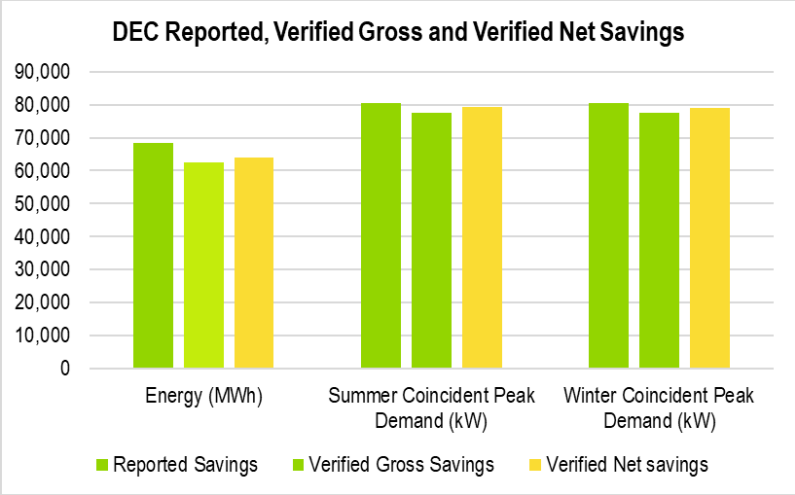
Guidehouse found the net-to-gross (NTG) ratio to be 1.02 for both DEC and DEP jurisdictions, meaning that for every 100 kWh of reported energy savings, 102 kWh can be attributed directly to the program. By multiplying the verified gross energy and demand savings by the NTG ratio, Guidehouse calculated the net energy and demand impacts shown in Table 1-1 for DEC and Table 1-2 for DEP. These findings will be discussed in greater detail throughout this report.

Table 1-1. SBES Reported, Verified Gross and Verified Net Savings - DEC

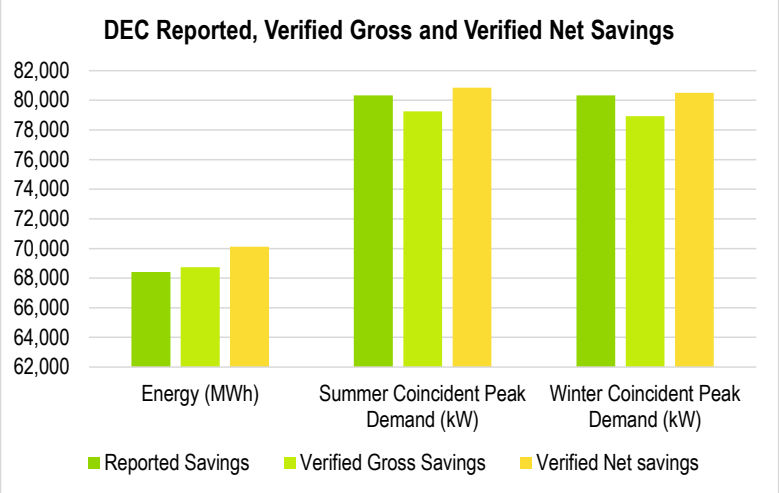
Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	68,413	80,343	80,343
Realization Rate	92%~~100%~~	97%~~99%~~	96%~~98%~~
Verified Gross Savings	62,613~~68,738~~	77,601~~79,256~~	77,523~~78,936~~
Net-to-Gross	102%	102%	102%
Verified Net savings	63,865~~70,113~~	79,153~~80,841~~	79,074~~80,515~~

Source: Guidehouse analysis, values subject to rounding.

Figure 1-1 Reported, Verified Gross and Net Energy and Demand Savings – DEC



Source: Guidehouse analysis, values subject to rounding.



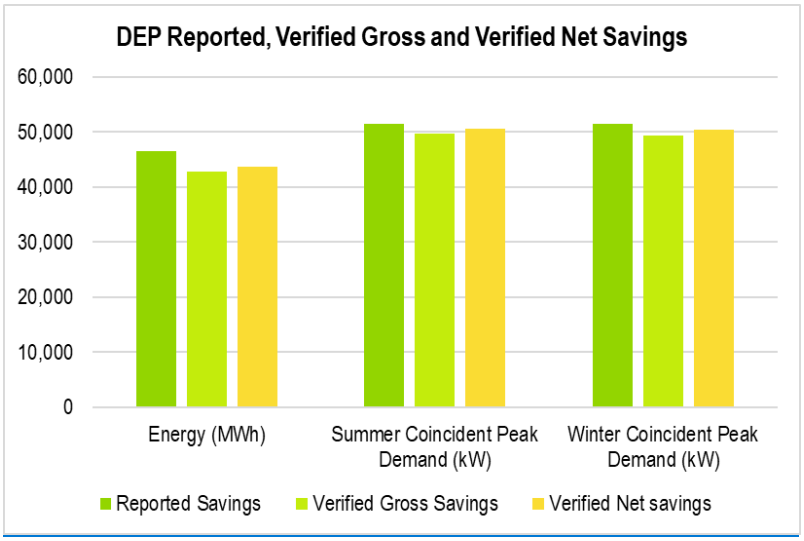
~~*Source: Guidehouse analysis, values subject to rounding.*~~

Table 1-2 SBES Reported, Verified Gross and Verified Net Savings – DEP

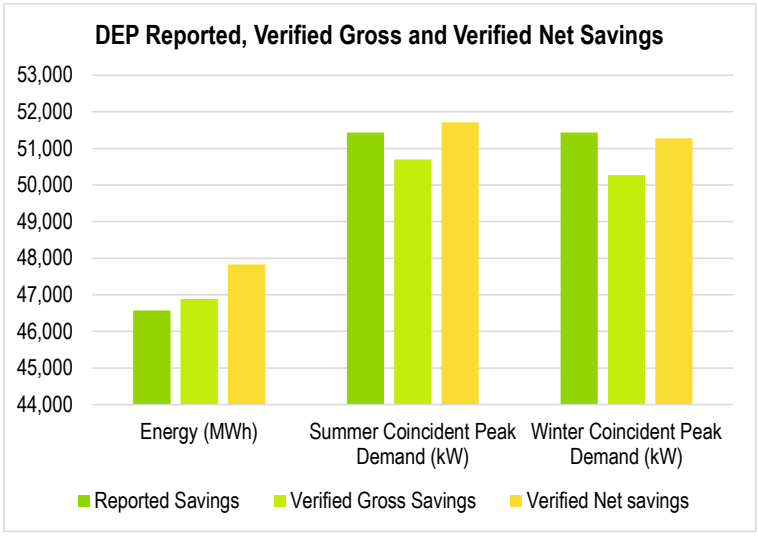
Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	46,571	51,433	51,433
Realization Rate	92%~~101%~~	97%~~99%~~	96%~~98%~~
Verified Gross Savings	42,852~~46,889~~	49,640~~50,696~~	49,383~~50,267~~
Net-to-Gross	102%	102%	102%
Verified Net savings	43,709~~47,827~~	50,633~~51,710~~	50,370~~51,272~~

Source: Guidehouse analysis, values subject to rounding.

Figure 1-2 Reported, Verified Gross and Net Energy and Demand Savings – DEP



Source: Guidehouse analysis, values subject to rounding.



Source: Guidehouse analysis, values subject to rounding.

1.3 Evaluation Parameters and Sample Period

To accomplish the evaluation objectives, Guidehouse performed a variety of research and analysis activities, including:

- Engineering review of measure savings algorithms
- Virtual verification to assess installed measure quantities and characteristics
- Participant surveys with customers to evaluate satisfaction and decision-making.

Table 1-3 summarizes the evaluated parameters. The targeted sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 2.5 percent.

Table 1-3. Evaluated Parameters

Evaluated Parameter	Description	Details
In-Service Rates	The percentage of program measures in use as compared to reported	Virtual verification assessments completed by participants
Satisfaction	Customer satisfaction	Process Surveys (Satisfaction with program elements Satisfaction with implementation contractor)
Free Ridership	Fraction of reported savings that would have occurred anyway, even in the absence of the program	NTG surveys
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	NTG surveys

Source: Guidehouse

The evaluation covers program participation from 1/1/2019 and 6/30/2020. Table 1-4 shows the start and end dates of Guidehouse' s sample period for evaluation activities.

Table 1-4. EM&V Sample Period Start and End Dates

Activity	Start Date	End Date
Virtual Verification	2/8/2021	3/05/2021
Process and NTG surveys	2/1/2021	2/26/2021

Source: Guidehouse

1.4 Evaluation Considerations and Recommendations

The evaluation team recommends a few actions for improving the SBES Program, based on insights gained through the evaluation effort. These recommendations are intended to assist Duke Energy with enhancing the program delivery and customer experience, as well as to possibly increase program impacts. Further explanation for each recommendation can be found later in this report.

1. **Consider introducing additional equipment choices in the program.** There were a subset of customers reporting that the program was unable to provide all the energy efficiency equipment they wanted. Duke Energy should consider introducing more equipment choices in the program to include additional outdoor lighting and HVAC measures. This also presents an opportunity for channeling to other Duke Energy programs or education about measures that are not offered through the SBES program.
2. **Increase and improve program communications.** This is the most common challenge or drawback received from participants, indicating that customers were sometimes unclear about the various stages of the program process and did not receive proper communication and guidance from the implementer and/or Duke Energy. Additional education from both Lime Energy and Duke Energy account managers should help customers better understand the program participation process.
3. **Consider using TRM algorithms for HVAC measures.** Lime Energy and Duke Energy developed deemed savings estimates using regional data for HVAC measures. Although the methodology for developing these estimates was accurate, Guidehouse recommends Duke Energy consider using TRM algorithms too and substituting the variables in these algorithms using regional values to estimate savings. This may enhance the transparency of the impact estimates for these measures.
4. **The Program Net-to-Gross Ratio is high**. This indicates that the program is providing a key service to small business customers in helping them manage their energy use.

2. Program Description

2.1 Program Design

The SBES Program is available to qualifying commercial customers with average demand less than 180 kilowatts (kW) demand service. After completing the program application to assess participation eligibility, customers receive a free energy assessment to identify equipment for upgrade. Lime Energy reviews the energy assessment results with the customer, who then chooses which equipment upgrades to perform. Qualified contractors complete the equipment installations at the convenience of the customer.

The SBES Program recognizes that customers with lower savings potential may benefit from a streamlined, one-stop, turnkey delivery model and relatively high incentives to invest in energy efficiency. Additionally, small businesses may lack internal staffing dedicated to energy management and can benefit from energy audits and installations performed by an outside vendor.

The program offers incentives in the form of a discount for the installation of measures, including high-efficiency lighting, refrigeration and HVAC equipment. These incentives increase adoption of efficient technologies beyond what would occur naturally in the market. During the period included in this evaluation, the SBES Program achieved the majority of program savings from lighting measures, which tend to be the most cost-effective and easiest to market to potential participants. The SBES program also achieved program savings from HVAC and refrigeration measures.

The program offers a performance-based incentive up to 80 percent of the total project cost, inclusive of both materials and installation. Multiple factors drive the total project cost, including selection of equipment and unique installation requirements.

2.2 Reported Program Participation and Savings

Duke Energy and the implementation contractor maintain a tracking database that identifies key characteristics of each project, including participant data, installed measures, and estimated energy and peak demand reductions based on assumed (“deemed”) savings values. In addition, this database contains measure level details that are useful for EM&V activities. Table 2-1 provides a summary of the gross reported energy and demand savings and participation for 2019-2020.

Table 2-1. Reported Participation and Gross Savings Summary

Reported Metrics	DEC	DEP
Projects	1,964	1,583
Measures Installed	21,909	16,853
Gross Annual Energy Savings (MWh)	68,413	46,571
Average Quantity of Measures per Project	11	10
Average Gross Savings Per Project (MWh)	34.83	29.41

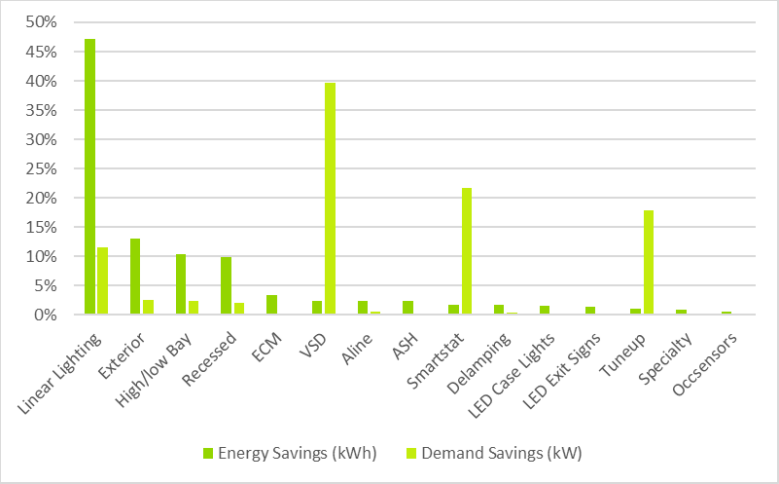
Source: SBES Tracking Database

Duke Energy uses assumptions and algorithms primarily from the New York Technical Resource Manual[1] (TRM) as the basis for energy and demand savings calculations[2] for lighting and refrigeration measures. This TRM is robust, well-established, and follows industry best practices for the measures found in the SBES program. The evaluation team believes the NY TRM is an appropriate basis for estimating savings in the DEC and DEP jurisdictions based on Guidehouse' s assessment of the underlying energy savings assumptions. Lime Energy worked with Duke Energy to develop the HVAC measures' deemed savings using regional data, Guidehouse reviewed the methodology for developing deemed savings estimates for these measures and think the deemed savings values are appropriate and agree with their use.

2.2.1 Program Summary by Measure

Efficient LED linear lighting retrofits were the highest contributor to program energy savings in 2019 -2020, followed by exterior lighting measures and a variety of LED lighting measures for DEC and DEP as seen in Figure 2-1 and Figure 2-2. However, HVAC measures such as VSD, Smart Thermostats and HVAC tune-ups contributed the most to demand savings for both jurisdictions. In addition, refrigeration measures (including EC motors, LED case lighting, and anti-sweat heaters) also contributed to savings. Overall, lighting measures contribute 86 percent of reported program energy savings, refrigeration measures contribute 9 percent and HVAC measures contribute the remaining 5 percent.

Figure 2-1. DEC Reported Gross Energy and Demand Savings by Measure Category

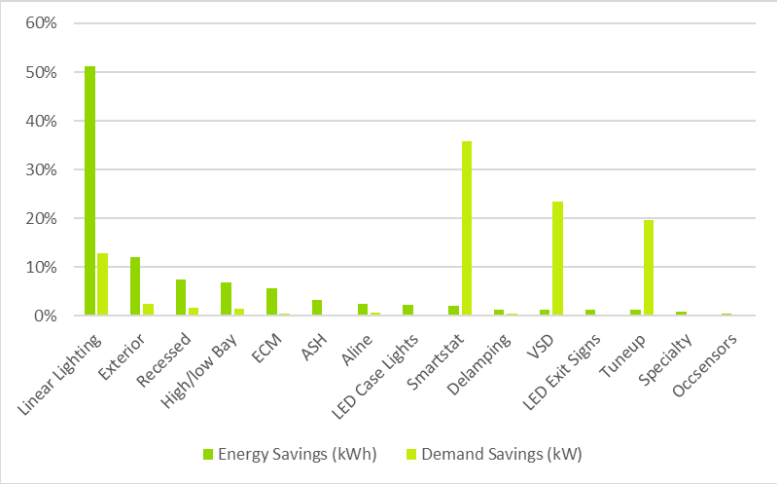


Source: SBES Tracking Database

[1] New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs - Residential, Multi-Family, and Commercial/Industrial, known as the Technical Resource Manual (TRM), Version 7, April 15, 2019

[2] The Pennsylvania Technical Reference Manual, 2016 is used for the anti-sweat heater control measure's algorithms and assumptions

Figure 2-2. DEP Reported Gross Energy and Demand Savings by Measure Category



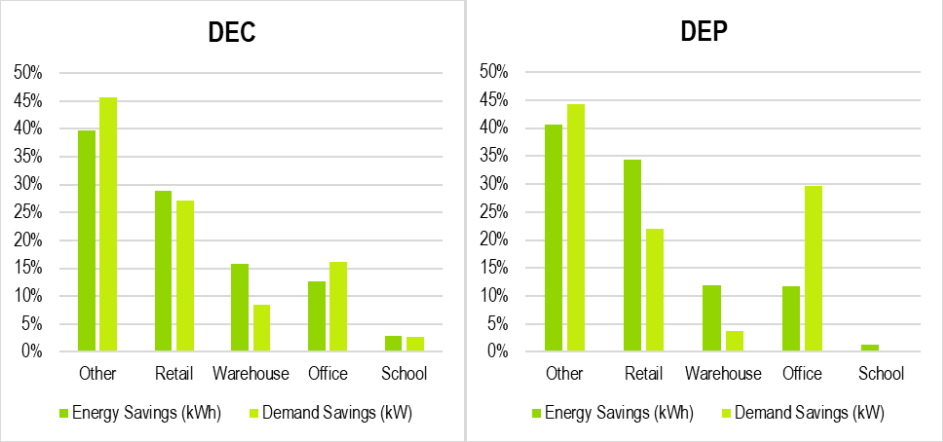
Source: SBES Tracking Database

2.2.2 Savings by Facility Type

Guidehouse reviewed the business type information in the tracking database to understand the participant demographics. The tracking data included SIC codes for each project, resulting in many unique detailed building types. As part of the engineering analysis for this evaluation, Guidehouse used the NEEP Mid-Atlantic TRM[3] to make impact adjustments to account for factors such as HVAC interactive effects and coincidence factors. To accomplish this, Guidehouse mapped the SIC codes from the tracking data to the facility types detailed in the TRM. The TRM HVAC interactive factors by facility fuel type are weighted by heating fuel multiplier factors determined from the participant virtual verification survey.

These facility types are shown below in Figure 2-3. Note that the largest category is "other", which indicates either the SIC code was not populated or a suitable TRM facility type was not found. The distribution of facility types is representative of a large variety of small business customers, indicating that the program is successfully recruiting participants across several sectors. The "other", retail, restaurant and warehouse facilities represent the largest contributors of energy and demand savings in both jurisdictions.

Figure 2-3. Reported Energy Savings by Facility Type



Source: SBES Tracking Database

[3]NEEP TRM (April 2020, v10), https://neep.org/sites/default/files/media-files/trmv10.pdf

3. Impact Evaluation

3.1 Impact Results

Table 3-1 shows the program-level results for gross energy and demand savings for DEC and DEP. The subsequent tables, Table 3-2, Table 3-3, and Table 3-4 show the end use level results for gross energy and demand savings for DEC and DEP. Guidehouse estimates gross realization rates of ~~100~~92%, ~~99~~97% and ~~98~~96% for DEC energy, summer coincident demand, and winter coincident demand, respectively. The gross realization rates for DEP are estimated as ~~101~~92%, ~~99~~97% and ~~98~~96% for energy, summer coincident demand, and winter coincident demand, respectively. The realization rates in these tables have been determined according to the in-service rates calculated based on the findings of the virtual verification survey as well as an engineering/deemed savings review of the algorithms.

Table 3-1 Reported and Verified Program-Level Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	68,413,344	80,343	80,343
	Realization Rate	92%~~100.4%~~	97%~~98.6%~~	96%~~98.2%~~
	Verified Gross Savings	62,612,654~~68,737,750~~	77,601~~79,256~~	77,523~~78,936~~
DEP	Reported Savings	46,571,185	51,433	51,433
	Realization Rate	92%~~100.7%~~	97%~~98.6%~~	96%~~97.7%~~
	Verified Gross Savings	42,852,171~~46,888,802~~	49,640~~50,696~~	49,383~~50,267~~

Source: Guidehouse analysis, values subject to rounding

Table 3-2 Reported and Verified Lighting Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	59,789,384	16,221	16,221
	Realization Rate	90%~~100.5%~~	83%~~93.3%~~	83%~~91.3%~~
	Verified Gross Savings	53,988,695~~60,113,791~~	13,479~~15,134~~	13,401~~14,814~~
DEP	Reported Savings	39,117,872	10,390	10,390
	Realization Rate	90%~~100.8%~~	83%~~92.9%~~	80%~~88.8%~~
	Verified Gross Savings	35,398,859~~39,435,490~~	8,596~~9,652~~	8,339~~9,223~~

Source: Guidehouse analysis, values subject to rounding

Table 3-3 Reported and Verified HVAC Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	3,666,767	63,700	63,700
	Realization Rate	100~~.8~~%	~~92.9~~100%	~~88.8~~100%
	Verified Gross Savings	3,666,767	63,700	63,700
DEP	Reported Savings	2,197,861	40,590	40,590
	Realization Rate	100~~.0~~%	100~~.0~~%	100~~.0~~%
	Verified Gross Savings	2,197,861	40,590	40,590

Source: Guidehouse analysis, values subject to rounding

Table 3-4 Reported and Verified Refrigeration Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	4,957,192	422	422
	Realization Rate	100.0%	100.0%	100.0%
	Verified Gross Savings	4,957,192	422	422
DEP	Reported Savings	5,255,451	453	453
	Realization Rate	100.0%	100.0%	100.0%
	Verified Gross Savings	5,255,451	453	453

Source: Guidehouse analysis, values subject to rounding

Table 3-5 below presents the energy, summer peak and winter peak impacts by the different measure categories in the DEC SBES program. Table 3-6 presents the same impacts by measure category for the DEP SBES program.

Table 3-5 Reported and Verified Measure-Level Impacts - DEC

Measure Category	Reported Savings (kWh)	Verified Energy Savings (kWh)	Energy Realization Rate	Reported Savings (kW)	Verified Demand Savings (Summer kW)	Summer Demand Realization Rate	Verified Demand Savings (Winter kW)	Winter Demand Realization Rate
A-Line Lamps	1,605,753	1,494,5741,697,337	93%106%	482	517580	107%120%	526591	109%123%
Anti Sweat Heater	1,602,710	1,597,7081,597,708	100%100%	38	3838	100%100%	3838	100%100%
De-lamping	1,137,371	974,2961,105,993	86%97%	390	370416	95%107%	273306	70%79%
ECM	2,302,550	2,302,5502,302,550	100%100%	263	263263	100%100%	263263	100%100%
Exterior Lights	8,886,092	8,440,0678,440,067	95%95%	2,007	00	0%0%	1,8961,896	94%94%
Bay Lights	7,146,435	6,072,8466,898,134	85%97%	1,909	2,0092,256	105%118%	2,0092,256	105%118%
LED Tubes	32,263,196	29,055,98132,956,441	90%102%	9,349	8,4359,471	90%101%	6,5137,312	70%78%
LED Case Lighting	1,084,809	1,084,8091,084,809	100%100%	121	121121	100%100%	121121	100%100%

LED Exit Signs	955,181	873,985991,480	91%104%	110	125140	114%128%	125140	114%128%
Occupancy Sensors	356,876	304,386346,393	85%97%	89	6472	72%80%	6472	72%80%
Recessed Lighting	6,729,790	6,120,3126,941,007	91%103%	1,706	1,7691,986	104%116%	1,8022,024	106%119%
Smart Thermostat	1,199,650	1,199,6501,199,650	100%100%	17,415	17,41517,415	100%100%	17,41517,415	100%100%
Specialty Lights	675,811	624,371709,064	92%105%	178	190213	106%119%	193217	108%122%
Tune-up	786,372	786,372786,372	100%100%	14,425	14,42514,425	100%100%	14,42514,425	100%100%
VSD	1,680,745	1,680,7451,680,745	100%100%	31,860	31,86031,860	100%100%	31,86031,860	100%100%
Grand Total	**68,413,344**	**62,612,65468,737,750**	**92%100%**	**80,343**	**77,60179,256**	**97%99%**	**77,52378,936**	**96%98%**

Source: Guidehouse analysis, values subject to rounding

Table 3-6 Reported and Verified Measure-Level Impacts – DEP

Measure Category	Reported Savings (kWh)	Verified Energy Savings (kWh)	Energy Realization Rate	Reported Savings (kW)	Verified Demand Savings (Summer kW)	Summer Demand Realization Rate	Verified Demand Savings (Winter kW)	Winter Demand Realization Rate
A-Line Lamps	1,161,239	1,077,4461,223,170	93%105%	372	398446	107%120%	405455	109%122%
Anti Sweat Heater	1,571,502	1,571,5021,571,502	100%100%	35	3535	100%100%	3535	100%100%
De-lamping	644,442	506,604577,129	79%90%	226	197221	87%98%	145163	64%72%
ECM	2,636,283	2,636,2832,636,283	100%100%	302	302302	100%100%	302302	100%100%
Exterior Lights	5,579,037	5,156,9725,156,972	92%92%	1,237	00	0%0%	1,1391,139	92%92%
Bay Lights	3,188,803	2,723,2203,088,653	85%97%	815	849953	104%117%	849953	104%117%
LED Tubes	23,850,441	21,627,14724,499,920	91%103%	6,650	6,0176,755	90%102%	4,6455,216	70%78%
LED Case Lighting	1,047,666	1,047,6661,047,666	100%100%	117	117117	100%100%	117117	100%100%
LED Exit Signs	603,599	558,875634,030	93%105%	69	7989	115%129%	7989	115%129%
Occupancy Sensors	228,693	187,035212,761	82%93%	57	4247	73%82%	4247	73%82%

Recessed Lighting	3,466,657	3,195,2993,626,739	92%105%	845	888997	105%118%	9041,016	107%120%
Smart Thermostat	1,008,250	1,008,2501,008,250	100%100%	18,439	18,43918,439	100%100%	18,43918,439	100%100%
Specialty Lights	394,961	366,260416,116	93%105%	119	128143	107%120%	130146	109%122%
Tune-up	563,167	563,167563,167	100%100%	10,137	10,13710,137	100%100%	10,13710,137	100%100%
VSD	626,444	626,444626,444	100%100%	12,014	12,01412,014	100%100%	12,01412,014	100%100%
Grand Total	**46,571,185**	**42,852,17146,888,802**	**92%101%**	**51,433**	**49,64050,696**	**97%99%**	**49,38350,267**	**96%98%**

Source: Guidehouse analysis, values subject to rounding

The following sections provide more details on the results, the methodology, and findings for the DEC and DEP impact evaluation.

3.2 Impact Evaluation Methodology

Guidehouse conducted an engineering-based analysis using standard savings algorithms to estimate the energy and demand impacts achieved by the program. The analysis was informed by virtual verification to validate measure quantities and characteristics as compared with information in the program tracking data. Additionally, Guidehouse reviewed relevant engineering parameters, such as HVAC interactive effects, and incorporated updates using the NEEP Mid-Atlantic TRM, participant virtual verification of heating fuel types, and 2016 Guidehouse logger analysis. The following subsections describe the methodology used for each element of this process, and the results are discussed in detail in Section 3.3.

3.2.1 Deemed Savings Review

Guidehouse conducted a deemed savings review to evaluate the energy and demand impacts reported in the tracking database for each measure type and category. Guidehouse evaluated all program measures and supporting data parameters. During the time period covered by this evaluation cycle, Lime Energy was the implementation contractor.

Guidehouse conducted a detailed review of the tracking data and impact estimates included within the documents provided by Duke Energy. Guidehouse replicated impact estimates using engineering calculations based on algorithms provided by Lime Energy and using measure parameters from the tracking data where available. Guidehouse also calculated preliminary ex post impacts for lighting measures that included basic modifications to include HVAC interactive effects and coincidence factors[4]. Based on these ex post impacts, Guidehouse calculated an "Engineering Review (ER)" verified realization rate which is the ratio of the savings calculated through the deemed savings review and the reported savings. See Section 3.3.1 for more information and findings from the deemed savings review.

[4] HVAC interactive effects in the savings calculations for indoor lighting measures were sourced from the NEEP Mid-Atlantic TRM and were based on building type and heating fuel type. The TRM interactive factors are weighted by the heating system fuel type multipliers derived from the participant virtual verification survey., with an assumption of AC and non-electric heating to be conservative

3.2.2 Sample Design

The participation data provided by Duke Energy indicated that the vast majority of energy savings are from lighting measures, with a small contribution of energy savings from refrigeration and HVAC measures. Guidehouse analyzed the program tracking data to characterize the trends in equipment and project size. Similar to previous evaluation cycles, Guidehouse stratified the evaluation sample by project size for lighting and grouped together refrigeration and HVAC measures. This allowed for a proper assessment of a range of projects while maximizing the proportion of total program savings that is represented by the evaluation. It should be noted that for calculations and reporting, HVAC and refrigeration measures were separated out of their combined strata.

Guidehouse used a combined sampling approach but considered strata-level characteristics of each jurisdiction. The combined sample design for both jurisdictions can be seen in Table 3-7 below. The original launch of the virtual verification did not produce the adequate amount of responses to fit the sample design, so more projects were needed to be added to the sample.

In addition to working with the Lime Energy database to create the sample population, the file was analyzed to create reported quantity totals for the lighting, HVAC, and refrigeration measures. This allowed the virtual verification to ask customers to confirm the quantity installed or provide a reason for a different verified quantity value.

Guidehouse targeted a 90/10 sampling confidence and relative precision for virtual verification at the program level. This expected sample size was approximately 107 projects for verification, seen in the tables below. This was based on a coefficient of variation of 0.5 for all strata, found in past field verification activities for this program. Guidehouse received a total of 90 completed impact surveys back from the sample, representing approximately 6,000 measures. The targeted sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 2.5 percent

Table 3-7 DEC Expected Sampling Summary

Stratum	Population Project Count	Verification Sample Size
Lighting Large	118	15
Lighting Medium	396	20
Lighting Small	1,969	21
HVAC and Refrigeration	1,065	51
Total	**3,548**	**107**

Source: Guidehouse analysis of DEC-DEP program tracking data

3.2.3 Virtual Verification

Guidehouse conducted verification for a sample of program participants to evaluate the consistency of measure characteristics with the program tracking database. Data collection was structured to gather the information necessary to inform the engineering algorithms used to estimate program impacts.

Guidehouse sent email invitations to a sample of participants. The virtual verification link was personalized so each participant only filled in the information relevant to their project. The virtual

verification survey was designed to take about 15-20 minutes for a participant to complete while present at their project location. Participants received an incentive of $25-$50 to compensate them for the time required to complete the virtual verification.

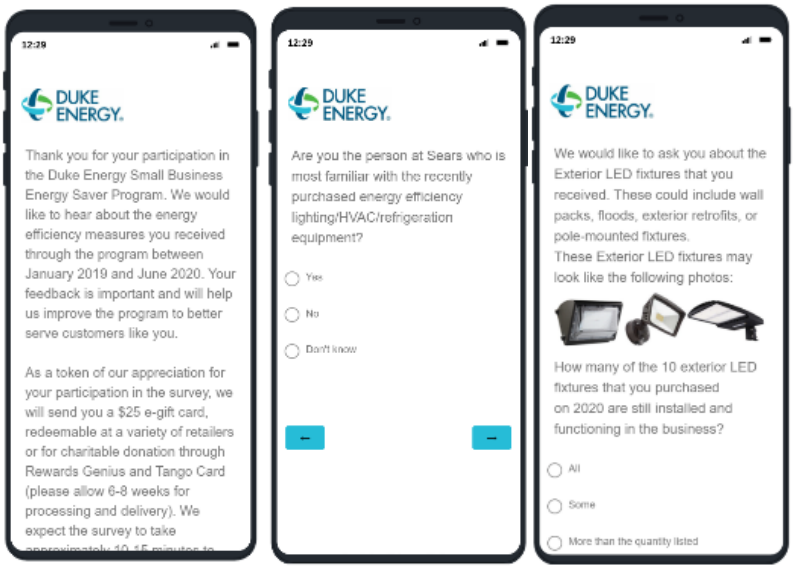
Guidehouse conducted a soft launch of the virtual assessment for a smaller sample of customers to test the process and determine response rates. Early feedback allowed for adjustments to maximize responses. Participants received reminders to complete the assessment. Guidehouse monitored the progress of completes relative to targets and designed a back-up sample to receive invitations when targets were not being met by the initial sample.

Guidehouse used the Qualtrics platform to create the virtual verification interface that participants used to collect key project information. The virtual verification requested photo documentation of certain project characteristics. Customers used a mobile device, such as a smartphone or tablet, to complete the verification process. The virtual verification included general questions about facility features and detailed questions about selected equipment.

Guidehouse asked questions about building HVAC characteristics, operating schedules, measure quantity, lamp/fixture wattage, and efficiency characteristics during the virtual verification. Due to the response rates for these various questions, Guidehouse only used verified measure quantities to update project savings. Guidehouse compared responses associated with heating and cooling system types and hours of operation to the database for consistency checks.

Figure 3-1 shows an example of the Qualtrics virtual verification platform. Participants used their mobile device to access the personalized link and open the interface in a web browser. In the equipment section, participants were prompted to upload pictures of the installed equipment using the camera on their mobile device. Guidehouse used a combination of participant-reported and documentation-based information to inform the verified energy and demand impact calculations.

Figure 3-1 Virtual Verification Platform Example



Source: Guidehouse Virtual Verification Qualtrics Survey

Survey invitations were sent to 2,202 participants between 2/08/2021 and 3/05/2021, with multiple reminders and escalating incentives. This includes all participants who did not receive invites for the process survey. Guidehouse also contacted 150 customers via phone which resulted in 7 additional customers taking the virtual verification survey. Ultimately, 302 participants began the survey, and 90 participants completed the questions in entirety. The 90 completed virtual impact surveys represented almost 6,000 individual measures.

Table 3-8 shows the virtual verification response summary by measure and includes the reported and verified measure quantities.

Table 3-8 Virtual Verification Response Summary by Measure

Measure	Number of Responses by Measure*	Reported Measure Quantity	Verified Measure Quantity
Specialty Lamps	6	56	56
LED Tubes	76	5,127	5,115
Tune-up	9	28	28
Bay Lights	3	91	26
Lighting Controls and Exit Signs	18	116	115
A-Line Lamps	20	167	156
Exterior Lights	14	75	75
Recessed Lights	10	236	233
VSD	3	12	12
De-lamping	1	8	8
Anti-Sweat Heaters	1	5	5
ECM	7	49	49
LED Case Lighting	4	9	9
Total	**172**	**5,979**	**5,887**

Source: Guidehouse Virtual Verification
**Respondents often had multiple measure categories in their projects*

3.3 Impact Evaluation Findings

This section examines findings from the deemed savings review and discusses the main drivers of the savings realization rates. Guidehouse calculates the realization rate as the verified savings divided by the reported savings by measure, which is driven by a combination of the in-service rate, the HVAC interactive effects, and the coincidence factors, described as follows:

1. In-Service Rate (ISR) is the ratio of the verified (i.e., installed) quantity to the reported quantity from the program tracking data.

2. HVAC Interactive Effects are multipliers that reflect effects on space heating and cooling loads caused by a reduction in heat output from efficient lighting. HVAC interactive effects only impact lighting measures. Note that the implementer did not apply HVAC interactive effects for any measures, so this adjustment is equal to the average HVAC interactive effect itself. There are separate adjustments for energy savings and demand savings.

3. Coincidence Factor (CF) represents the portion of installed lighting that is on during the peak utility hours. This affects only demand reductions, not energy savings.

Overall, in-service rates tend to result in minor decreases to the verified energy savings, while HVAC interactive effects result in an increase in savings for lighting measures. Generally, the application of coincidence factor results in decreased demand savings for lighting measures.

3.3.1 Deemed Savings Review

Guidehouse reviewed the program tracking data provided by Duke Energy to assess program activity and the availability of key data fields necessary to support the evaluation. The pre- and post-retrofit measure descriptions summarize the equipment details for each line item in the database, and Guidehouse was able to identify the fields that correspond to ex ante (i.e., reported) energy and demand impacts.

The lighting controls, anti-sweat heater controls, LED case lighting, and refrigeration ECM motor measures were initially lacking information in the Lime Energy tracking data. Lime Energy then provided additional documentation to assist in the review of the program tracking data. Guidehouse used this to confirm that the Lime Energy lighting and refrigeration measure savings in the tracking data align with the algorithms from the New York and Pennsylvania Technical Reference Manuals, as in prior evaluations of this program.

Lime Energy also provided their HVAC measure deemed savings table and provided some background on how those values were developed.

3.3.1.1 Anti-Sweat Heater Controls

Lime Energy calculated the anti-sweat heater controls measure savings using the algorithms from the Pennsylvania TRM.

Refrigerator/Cooler

$$\mathrm{D}kWh_{per\ unit} = \frac{kW_{coolerbase}}{DoorFt} \times \left(8{,}760 \times CHA_{off}\right) \times \left(1 + \frac{R_h}{COP_{cool}}\right)$$

$$\Delta kW_{peak\ per\ unit} = \frac{kW_{coolerbase}}{DoorFt} \times CHP_{off} \times \left(1 + \frac{R_h}{COP_{cool}}\right) \times DF$$

Freezer

$$\mathrm{D}kWh_{per\ unit} = \frac{kW_{freezerbase}}{DoorFt} \times \left(8{,}760 \times FHA_{off}\right) \times \left(1 + \frac{R_h}{COP_{freeze}}\right)$$

$$\Delta kW_{peak\ per\ unit} = \frac{kW_{freezerbase}}{DoorFt} \times FHP_{off} \times \left(\frac{R_h}{COP_{freeze}}\right) \times DF$$

where:

N	= Number of doors or case length in linear feet having ASH controls installed
R_h	= Residual heat fraction; estimated percentage of the heat produced by the heaters that remains in the freezer or cooler case and must be removed by the refrigeration unit
$Unit$	= Refrigeration unit

8,760	= Hours in a year
$kW_{cooler\ base}$	= Per door power consumption of cooler case ASHs without controls
CHP_{off}	= Percent of time cooler case ASH with controls will be off during the peak period
CHA_{off}	= Percent of time cooler case ASH with controls will be off annually
DF_{cool}	= Demand diversity factor of cooler, accounting for the fact that not all anti-sweat heaters in all buildings in the population are operating at the same time.
COP_{cool}	= Coefficient of performance of cooler
$kW_{freezerbase}$	= Per door power consumption of freezer case ASHs without controls
FHP_{off}	= Percent of time freezer case ASH with controls will be off during the peak period
FHA_{off}	= Percent of time freezer case ASH with controls will be off annually
DF_{freeze}	= Demand diversity factor of freezer, accounting for the fact that not all anti-sweat heaters in all buildings in the population are operating at the same time.
COP_{freeze}	= Coefficient of performance of freezer

3.3.1.2 Electronically Commutated Motors

Lime Energy calculated the electronically commutated motor for Walk-In/Reach-In units measure savings using the algorithms from the New York TRM.

Annual Electric Energy Savings

$$\Delta kWh = \Delta kWh_{EFan} + \Delta kWh_{RH}$$

$$\Delta kWh_{EFan} = units \times \left(\frac{A_{EFan} \times V_{EFan} \times \sqrt{Phase_{EFan}}}{1{,}000}\right) \times F_{PA} \times F_{EFan} \times hrs_{EFan}$$

$$\Delta kWh_{RH} = \Delta kWh_{EFan} \times Comp_{Eff} \times 0.284$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \Delta kW_{EFan} + \Delta kW_{RH}$$

$$\Delta kW_{EFan} = units \times \left(\frac{A_{EFan} \times V_{EFan} \times \sqrt{Phase_{EFan}}}{1{,}000}\right) \times F_{PA} \times F_{EFan} \times CF$$

$$\Delta kW_{RH} = \Delta kW_{EFan} \times Comp_{Eff} \times 0.284$$

where:

ΔkWh	= Annual electric energy savings
ΔkW	= Peak coincident demand electric savings
$\Delta therms$	= Annual gas energy savings
ΔkWh_{EFan}	= Annual electric savings due to evaporator fan motor replacement
ΔkWh_{RH}	= Annual electric savings due to reduced heat from evaporator fan motor replacement
ΔkW_{EFan}	= Summer Peak Coincident Demand Savings due to evaporator fan motor replacement
ΔkW_{RH}	= Summer Peak Coincident Demand Savings due to reduced heat from evaporator fan motor replacement
units	= Number of measures installed under the program
A_{EFan}	= Nameplate amperage of existing evaporator fan motor
V_{EFan}	= Nameplate voltage of existing evaporator fan motor
$Phase_{EFan}$	= Phase of existing evaporator fan
1,000	= Conversion factor, one kW equals 1,000 W
F_{PA}	= Power factor
F_{EFan}	= Reduction of load by replacing evaporator fan motor
hrs_{EFan}	= Evaporator fan annual operating hours
$Comp_{Eff}$	= Efficiency of the cooler/freezer compressor (kW/Ton)
0.284	= Conversion factor from kW to Tons of refrigeration (Tons/kW)
CF	= Coincidence factor

3.3.1.3 Refrigerated LED Case Lighting

Lime Energy calculated the refrigerated LED case lighting measure savings using the algorithms from the New York TRM.

Annual Electric Energy Savings

$$\Delta kWh = \left(\frac{(W \times units)_{baseline} - (W \times units)_{ee}}{1{,}000}\right) \times hrs \times (1 + (Comp_{eff} \times 0.284))$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \left(\frac{(W \times units)_{baseline} - (W \times units)_{ee}}{1{,}000}\right) \times CF \times (1 + (Comp_{Eff} \times 0.284))$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
Δtherms	= Annual gas energy savings
units	= Number of measures installed under the program
W	= Rated wattage of lamp or fixture (Watts)
$_{baseline}$	= Baseline condition or measure
$_{ee}$	= Energy efficient condition or measure
1,000	= Conversion factor, one kW equals 1,000 Watts
hrs	= Lighting operating hours
CF	= Coincidence factor
$Comp_{Eff}$	= Efficiency of the cooler/freezer compressor (kW/Ton)
0.284	= Conversion factor from kW to Tons of refrigeration (Tons/kW)

3.3.1.4 HVAC Measures Deemed Savings

Lime Energy worked with Duke Energy to determine the deemed savings for the HVAC measures: fan motor VSDs, HVAC tune-ups, and smart thermostats. For VSDs, Lime Energy provided engineering algorithm(s) used to calculate the energy savings values to support the determination of deemed savings values. For smart thermostats and HVAC tune-ups, deemed savings values were provided to Lime Energy. Lime Energy's regional adjustment methodology for smart thermostats and HVAC tune-ups used 5 years of cooling degree day comparisons with a base temperature of 60 degrees Fahrenheit. There was no adjustment for the VSD measure since VSDs have very little weather dependence.

Since Lime Energy worked with Duke Energy to develop the HVAC measures' deemed savings using regional data, we think the deemed savings values are appropriate and agree with their use.

3.3.1.5 Lighting Controls

Lime Energy also shared the following algorithm used to calculate the lighting control measure energy savings:

$$kWh = \left[kW_{before} * Qty_{before} * \left(Hours * (1 - ReductionFactor)\right)\right] - \left[kW_{after} * Qty_{after} * \left(Hours * (1 - ReductionFactor)\right)\right]$$

The ReductionFactor variable Lime Energy used is equal to 0.3. Guidehouse was unable to replicate the lighting control savings since baseline wattage data was not provided.

3.3.1.6 Lighting Measures

As outlined in previous EM&V reports and in following the best practices for commercial lighting impact verification, Table 3-9 shows the algorithms used by Guidehouse to calculate the savings for the lighting measures. These algorithms are similar to those commonly found in technical reference manuals for commercial lighting measures and match the methodology outlined in the New York TRM. Lime Energy followed similar algorithms to calculate lighting measure savings but did not include HVAC interactive effects or coincidence factors (for demand savings only). A discussion on each impact parameter is included after the table.

Table 3-9 Engineering Algorithms for Lighting Measures

Measure	Energy Savings Algorithm	Coincident Peak Demand Savings Algorithm
Lighting Measures	$kWh = ISR * \frac{(W_b * Qty_b) - (W_{ee} * Qty_{ee})}{1000} * HOU * IF\_Energy$	$kW = ISR * \frac{(W_b * Qty_b) - (W_{ee} * Qty_{ee})}{1000} * CF * IF\_Demand$
ISR = in-service rate*		
Qty_b = baseline quantity of equipment		
Qty_ee = efficient quantity of equipment		
HOU = operating hours		
Watts_b = baseline watts		
Watts_ee = efficient watts		
CF = coincidence factor		
IF_Energy = heating, ventilating, and air conditioning (HVAC) interaction factor for energy savings calculations		
IF_Demand = interaction factor for demand savings calculations		

**Guidehouse did not apply an ISR to the preliminary ex post impacts. ISRs were applied based on findings from evaluation activities. Source: Guidehouse analysis*

Baseline and Efficient Wattage

Based on the measure descriptions in the tracking database, estimates for baseline and efficient wattage appeared to be reasonable and are likely accurate records of project equipment and specifications. The virtual verification survey supported the wattage information provided in the tracking database, as a small subset of respondents provided wattage information.

HVAC Interactive Effects for Energy and Demand

The HVAC interactive effects represent additional HVAC impacts due to changes in heating and cooling load for lighting measures located in conditioned spaces. The tracking databases did not apply HVAC interactive effects for any lighting measures. Guidehouse applied~~, which resulted in~~ adjustments to the energy and demand savings during Guidehouse' s engineering review. The HVAC Interactive effects by building type as presented in Table 3-12~~Table 3-6~~ were applied from the NEEP Mid-Atlantic TRM to the verified savings as calculated from the engineering review and adjusted by virtual verification findings on heating and cooling system fuel types.

Coincidence Factor (CF)

The tracking database included a single demand savings field for lighting measures, which does not incorporate a coincidence factor. Guidehouse interpreted the demand impacts in the tracking data as non-coincident impacts, and the evaluation incorporated summer and winter coincidence factors to calculate kW impacts for reporting purposes. Table 3-13~~Table 3-7~~ and Table 3-14~~Table 3-8~~ present the summer and winter peak coincident factors that were used in the calculation of the verified demand savings stemming from the engineering review.

3.3.2 HVAC Interactive Effects

HVAC interactive effects are the lighting-HVAC interaction factors that represent the reduced space cooling requirements due to the reduction of waste heat rejected by efficient lighting. Because of this, HVAC interactive effects are not applicable to exterior lighting measures. Note that the implementor did not apply HVAC interactive effects for any of the lighting measure savings~~s~~ claimed in the program year. The HVAC interactive effects shown in Table 3-10 are sourced from Appendix E (Commercial & Industrial Lighting Waste Heat Factors) in the NEEP Mid-Atlantic TRM and are based on building type[5]. The TRM interactive effects by fuel types were adjusted after analyzing participant response of their facility's heating and cooling system fuel types from the virtual verification survey (64 of the 90 respondents as shown in Table 3-11). Guidehouse then determined the multiplier factors shown in Table 3-12 and applied them to the TRM factors to get the weighted HVAC interactive effects in Table 3-13.

Field Code Changed

The evaluation team applied the weighted HVAC interactive effects to both the energy and demand savings calculations for the interior lighting measures. The HVAC interactive effects adjustment is between 0.89~~1.00~~ and 0.97~~1.10~~ for energy and 1.10 and 1.28~~44~~ for demand.

Table 3-10 NEEP Mid-Atlantic TRM HVAC Interactive Factors

Building Type	Demand Waste Heate Factor (WHFd)		Annual Energy Waste Heat Factor by Cooling/Heating Type (WHFe)				
	AC (Utility)	AC (PJM)	AC/Non Elec	AC/Elec Res	Heat Pump	NoAC/EleCRes	NoAC/Non Elec
Office	1.36	1.32	1.10	0.85	0.94	0.75	1.00
Retail	1.27	1.26	1.06	0.83	0.95	0.77	1.00
School	1.44	1.44	1.10	0.81	0.96	0.71	1.00
Warehouse	1.23	1.24	1.02	0.75	0.89	0.73	1.00
Other	1.35	1.33	1.08	0.82	0.93	0.74	1.00

Source: NEEP Mid-Atlantic TRM (v10).

Table 3-11 Virtual Verification Responses on Heating and Cooling System Fuel Types

Response	Response Option	Count	97 Other - Response Count	Total Count
1	Gas Heating with AC	26		26
2	Gas Heating with no AC	3	1	4
3	Electric Heating with AC	23	1	24
4	Electric Heating with no AC	1	1	2
5	Heat Pump heating and cooling	7		7
	No heating and cooling	0	1	1

[5] NEEP TRM (April 2020, v10), https://neep.org/sites/default/files/media-files/trmv10.pdf . The HVAC interactive effects (or waste heat factors) used are for Maryland buildings.~~with AC and non-electric heat.~~

Source: DEC-DEP 2020-2021 virtual verification survey data analysis.

Table 3-12 HVAC Interactive Effects Multipliers from the Participant Virtual Verification~~NEEP Mid-Atlantic TRM~~

Heating Responses	Total	AC/NonElec	AC/ElecRes	Heat Pump	NoAC/ElecRes	NoAC/NonElec
Count	63	26	24	7	2	4
Weights		41%	38%	11%	3%	6%

Cooling Responses	Total	AC	No AC
Count	64	57	7
Weights		89%	11%

Source: DEC-DEP 2020-2021 virtual verification survey data analysis.

Table 3-13 Weighted HVAC Interactive Effects ~~Multipliers from the NEEP Mid-Atlantic TRM~~

Building Type	TRM Values Weighted by Survey Heating Fuel Type WHFe	TRM Values Weighted by Survey Cooling Fuel Type WHFd
Office	0.97	1.21
Retail	0.95	1.13
School	0.96	1.28
Warehouse	0.89	1.10
Other	0.95	1.20

Source: NEEP Mid-Atlantic TRM Lighting HVAC interactive factors weighted by participant survey HVAC interactive multipliers in Table 3-12~~1~~.

~~Building Type~~	~~WHFe~~	~~WHFd~~
~~Office~~	~~1.10~~	~~1.36~~
~~Retail~~	~~1.06~~	~~1.27~~
~~School~~	~~1.10~~	~~1.44~~
~~Warehouse~~	~~1.02~~	~~1.23~~
~~Other~~	~~1.08~~	~~1.35~~

HVAC interactive effects and coincidence factors are the main reason for discrepancy between the reported and verified savings in interior lighting measures. The addition of HVAC interactive effects to the energy savings calculations resulted in a decrease~~n increase~~ of energy savings. The addition of the HVAC interactive effects to the demand savings resulted in an increase in

demand savings but the gains were offset by the application of demand coincidence factors, which resulted in overall a lower demand savings.

3.3.3 Coincidence Factors

To develop summer and winter coincidence factors for the lighting measures, Guidehouse used findings from the lighting logger measurements conducted during the 2016 DEC-DEP evaluation. Coincidence factors account for the fact that not all lights are on for the duration of the peak demand period. Coincidence factors range from 0.0 and 1.0, based on measure type, and are detailed in Table 3-14~~Table 3-11~~ below. The implementer did not apply coincidence factors to the demand savings for lighting measures. LED exit signs that are on all day receive a summer and winter coincidence factor on 1.0, while exterior lights receive a summer coincidence factor of 0.0 and winter coincidence factor of 1.0.

Lighting controls have a separate set of coincidence factors based on building type, similar to the HVAC interactive effects. There coincidence values come from the NEEP Mid-Atlantic TRM Appendix E (Commercial & Industrial Lighting Waste Heat Factors) and can be found in Table 3-15~~Table 3-12~~.

Table 3-14 Summer and Winter Coincidence Factors for Lighting Measures from DEC-DEP 2016 Logger Analysis

Measure	Summer Coincidence Factor	Winter Coincidence Factor
LED Exit Sign	1	1
A Line Lamp	0.914	0.931
Recessed Light	0.914	0.931
Specialty Light	0.914	0.931
LED Tube	0.802	0.619
High/low Bay	1	1
Delamping	0.902	0.664
Exterior Light	0	1

Source: DEC-DEP 2016 logger data analysis.

Table 3-15 Coincidence Factors for Lighting Controls from the NEEP Mid-Atlantic TRM

Building Type	Coincidence Factor
Office	0.70
Retail	0.83
School	0.35
Warehouse	0.80
Other	0.62

Source: NEEP Mid-Atlantic TRM

3.3.4 Engineering Review (ER) Realization Rate

During the engineering review process, Guidehouse used the HVAC interactive effects as well as summer and winter peak coincident factors to adjust the deemed impacts.

On average the addition of HVAC energy interactive effects resulted in a~~n~~ ~~inde~~crease of ~~5~~4% in energy savings. The addition of HVAC demand interactive effects and coincidence peak demand factors resulted in a decrease of 3% in demand savings. ~~and 25% in demand savings. The addition of coincident peak demand factors resulted in an average decrease of 20% in summer peak demand savings and 25% in winter peak demand savings.~~

Table 3-16~~-~~ and Table 3-17 show the realization rates stemming from the engineering review for energy, summer peak and winter peak demand savings for each stratum.

Table 3-16 DEC Engineering Review (ER) Realization Rate

Stratum	Energy Realization Rate	Summer Peak Demand Realization Rate	Winter Peak Demand Realization Rate
Lighting Large	94%~~105%~~	86%~~97%~~	89%~~98%~~
Lighting Medium	95%~~106%~~	86%~~96%~~	88%~~97%~~
Lighting Small	95%~~106%~~	90%~~101%~~	84%~~93%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**96%~~105%~~**	**97%~~100%~~**	**97%~~99%~~**

Source: Guidehouse Engineering Review

Table 3-17 DEP Engineering Review (ER) Realization Rate

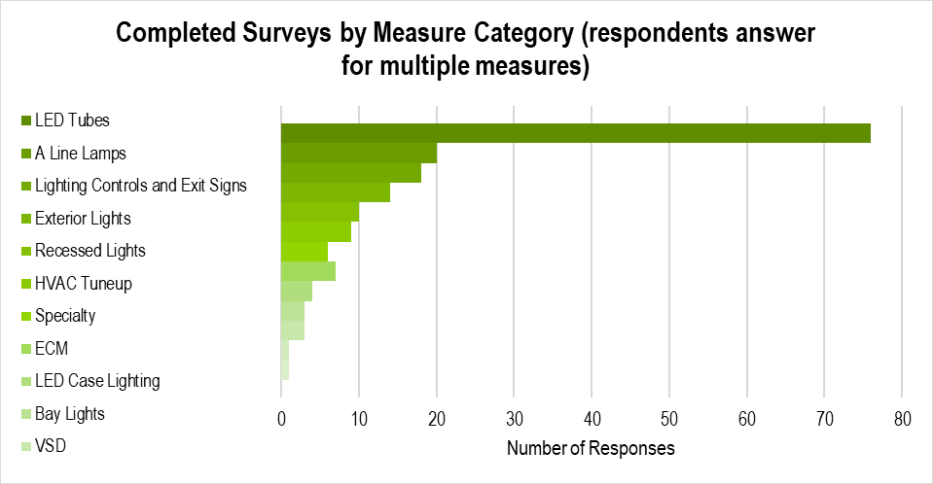
Stratum	Energy Realization Rate	Summer Peak Demand Realization Rate	Winter Peak Demand Realization Rate
Lighting Large	95%~~104%~~	78%~~88%~~	86%~~108%~~
Lighting Medium	95%~~106%~~	86%~~96%~~	87%~~99%~~
Lighting Small	95%~~107%~~	93%~~104%~~	81%~~87%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**96%~~105%~~**	**97%~~99%~~**	**97%~~99%~~**

Source: Guidehouse Engineering Review

3.3.5 In-Service Rates (ISR)

Guidehouse analyzed the responses to the virtual verification survey to identify the verified quantities of equipment installed. Guidehouse calculated the ISR as a ratio between the findings from the virtual verification and the quantities reported in the program-tracking databases. As seen in Figure 3-2, Guidehouse received responses to questions representing the majority of program measure categories.

Figure 3-2 Survey Responses by Measure Category



Source: Guidehouse Virtual Verification

Table 3-18~~Table 3-15~~ shows the reported and verified quantities by stratum as collected from the virtual verification survey. Although the number of completed virtual assessments was slightly lower than Guidehouse' s target, this did not impact the precision goals of the evaluation. This is because in-service rates (ISR) at the site level were still extremely high within the sample group, with a 96% realization rate ISR from the survey alone. A table of ISR by stratum can be seen below in Table 3-19~~Table 3-16~~.

Table 3-18 Response Summary by Stratum

Stratum	Sample Size	Sample Reported Quantity	Sample Verified Quantity
Lighting Large	3	1,039	965
Lighting Medium	9	2,549	2,546
Lighting Small	53	2,288	2,273
HVAC	14	40	40
Refrigeration	11	63	63
Total	**90**	**5,979**	**5,887**

Source: Guidehouse Virtual Verification

Table 3-19 Verification Energy Realization Rate ISR

Stratum	ISR
Lighting Large	85%
Lighting Medium	100%
Lighting Small	100%
HVAC	100%
Refrigeration	100%
Total	**96%**

Source: Guidehouse Virtual Verification

As shown in Table 3-20~~Table 3-17~~ below, the ISR for each measure varied from 29% to 100%. The high/low bay lights measure had the lowest ISR of 29% while the rest of the measures had ISR between 93% and 100%. 11 out of the 13 measure categories had an ISR between 99% and 100%.

Table 3-20 Virtual Verification In-Service Rates Findings

Measure	ISR
Specialty Lamps	100%
LED Tubes	100%
Tune-up	100%
Bay Lights	29%
Lighting Controls and Exit Signs	99%
A-Line Lamps	93%
Exterior Lights	100%
Recessed Lights	99%
VSD	100%
De-lamping	100%
Anti-Sweat Heaters	100%
ECM	100%
LED Case Lighting	100%

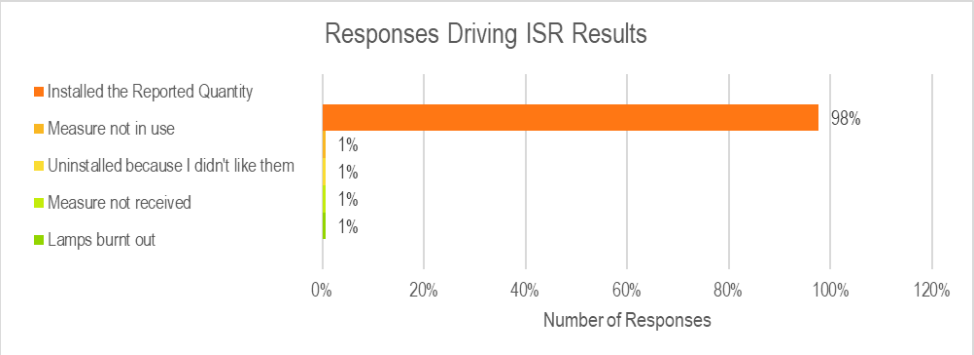
Source: Guidehouse Virtual Verification

**90 virtual verification surveys were completed, with respondents answering questions about multiple measures*

The majority of respondents (98%) reported that they installed the quantity of their measure that was reported in the program tracking data, as shown in Figure 3-3. Four percent of the respondents said that the quantities reported in the program tracking data for their measure were either no longer installed or were never installed. One percent of respondents said the measure is no longer in use, with no further explanation. One percent of respondents said they uninstalled the measure because they didn't like it. One percent said they never received the measure and the last 1% said their lamps burnt out, so they are no longer installed.

Overall, the ISR values are high and indicate the program is accurately tracking installed measures. Additionally, even though the ISRs decreased for some measures, overall energy savings increased through the application of HVAC interactive effects that were added in during the engineering review. The lighting large strata was the only strata that saw an overall decrease in energy savings due to the ISR.

Figure 3-3 Responses Driving ISR Results



Source: Guidehouse Virtual Verification

3.1 Verified Realization Rates based on ISR and ER

This section presents the overall realization rates based on verified gross savings, separated out by jurisdiction. This process includes merging the realization rates calculated based on the engineering review and in-service rates from the virtual verification assessments.

Table 3-21~~Table 3-18~~ presents the overall realization rates for DEC, and Table 3-23~~Table 3-20~~ presents the DEP overall realization rates. Table 3-22~~Table 3-19~~ and Table 3-24~~Table 3-21~~ present the realization rates by end use for DEC and DEP respectively. As mentioned in earlier sections, the virtual verification assessments were used to determine in-service rates (ISRs) for each category. Guidehouse calculated separate impacts using an engineering review (ER) process that included applying algorithms from the New York and Pennsylvania TRMs and measure characteristics from the program tracking data. The total realization rates were obtained using both the verified quantity from the surveyed customers and the engineering review calculations. The ER energy realization rate was ~~105~~96% for DEC and DEP and the ISRs was 96%.

These realization rates were impacted by the interactive effects in the engineering review calculations. For both programs, these interactive effects ~~increased~~ decreased the verified savings below~~above~~ the reported savings, and the ISR from the virtual verification decreased the verified savings slightly to bring both realization rates to their final values of ~~100~~92% for both DEC and DEP~~and 101%~~. Figure 3-4 and Figure 3-5 show how each calculation method impacted the realization rate for each stratum, as well as the jurisdictions' overall realization rate.

Table 3-21 Energy Installation Rate by Strata – DEC

Stratum	ER	ISR	Total Energy Realization Rate
Lighting Large	94%~~105%~~	85%~~85%~~	80%~~89%~~
Lighting Medium	95%~~106%~~	100%~~100%~~	95%~~106%~~
Lighting Small	95%~~106%~~	100%~~100%~~	95%~~106%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**96%~~105%~~**	**96%~~96%~~**	**92%~~100%~~**

Source: Guidehouse analysis, values subject to rounding.

Table 3-22 Energy Installation Rate by End Use – DEC

End Use	ER	ISR	Total Energy Realization Rate
Lighting Large	95%~~106%~~	96%~~96%~~	90%~~101%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**96%~~105%~~**	**96%~~96%~~**	**92%~~100%~~**

Source: Guidehouse analysis, values subject to rounding.

Table 3-23. Energy Realization Rate by Strata – DEP

Stratum	ER	ISR	Total Energy Realization Rate
Lighting Large	95%~~104%~~	85%~~85%~~	80%~~89%~~
Lighting Medium	95%~~106%~~	100%~~100%~~	95%~~106%~~
Lighting Small	95%~~107%~~	100%~~100%~~	95%~~107%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**96%~~105%~~**	**96%~~96%~~**	**92%~~101%~~**

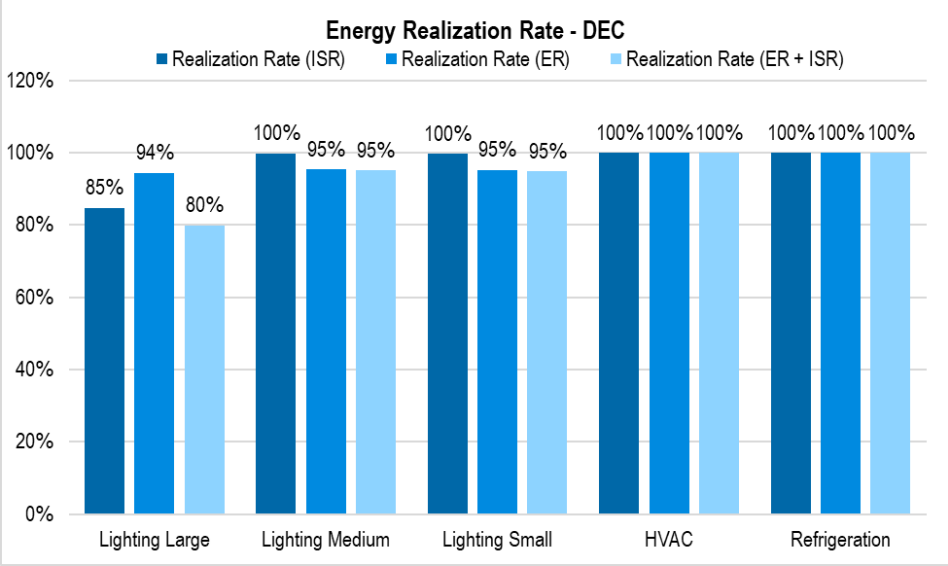
Source: Guidehouse analysis, values subject to rounding.

Table 3-24 Energy Installation Rate by End Use – DEP

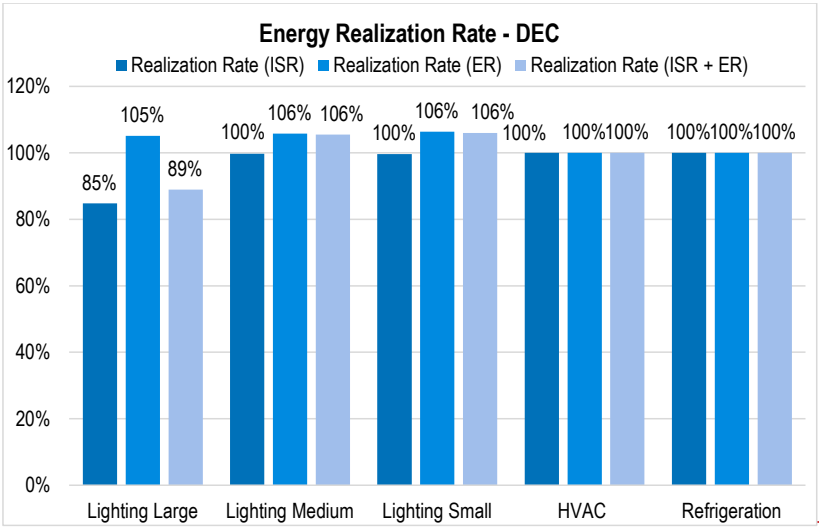
End Use	ER	ISR	Total Energy Realization Rate
Lighting	95%~~106%~~	96%	90%~~101%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**96%~~105%~~**	**96%~~96%~~**	**92%~~101%~~**

Source: Guidehouse analysis, values subject to rounding.

Figure 3-4 Comparison of Energy Savings Realization Rates by Strata – DEC

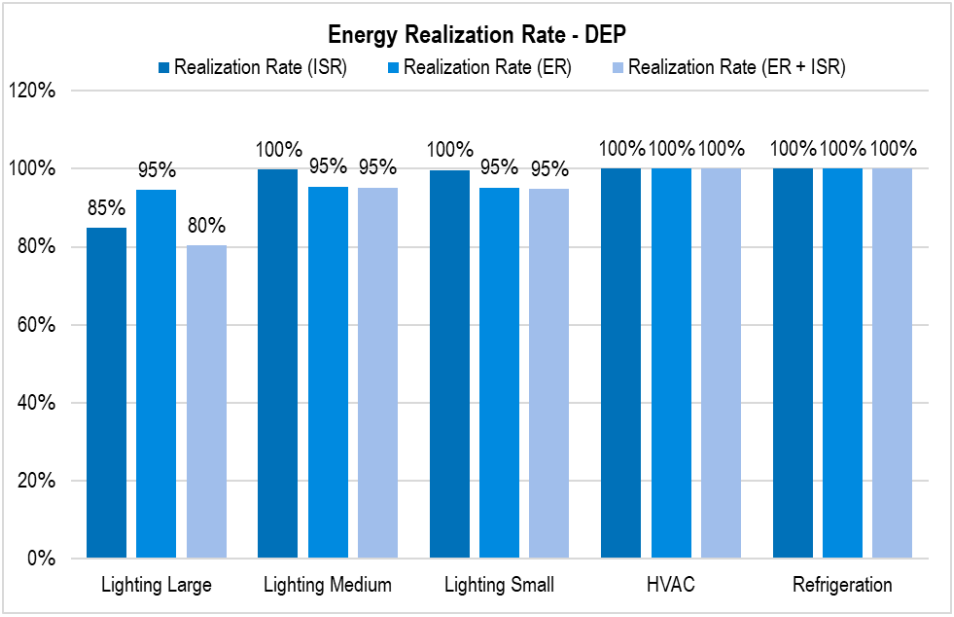


Source: Guidehouse analysis, values subject to rounding.

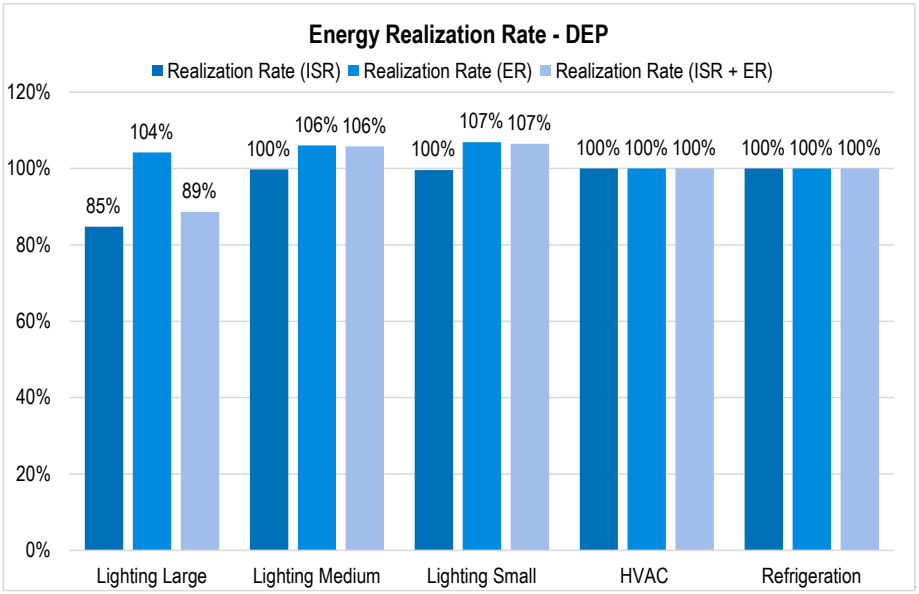


~~Source: Guidehouse analysis, values subject to rounding.~~

Figure 3-5 Comparison of Energy Savings Realization Rates by Strata – DEP



Source: Guidehouse analysis, values subject to rounding.



~~*Source: Guidehouse analysis, values subject to rounding.*~~

The summer and winter peak overall realization rates are shown in the tables below, broken out by jurisdiction. The in-service rates for DEC and DEP demand savings were relatively high at 99% for both summer and winter. The ER realization rates for summer and winter peak are impacted by the HVAC interactive effects and coincidence factors (summer and winter).The total realization rate combines these two verification savings methods. Table 3-25~~Table 3-22~~ to Table 3-32~~Table 3-29~~ below lay out the jurisdictions' realization rates by season, strata and end use.

For the DEC jurisdiction, the overall summer demand realization rate is ~~99~~97%. This is because the interactive effects and summer coincidence factors ~~increased~~ decreased ~~or held~~ the realization rate ~~close to 100%~~ while the verified quantities significantly reduced the Lighting Large realization rate, so the factors balanced each other out in the final realization rate. The jurisdiction's overall winter demand realization rate was ~~slightly~~ lower at 98% due to a stronger impact on the Lighting Small strata in addition to the summer realization rate's reasoning, resulting in an overall winter peak realization rate of ~~98~~96%. Figure 3-6 and Figure 3-8 show how each calculation method impacted the summer and winter realization rate for each of DEC's stratum, respectively.

The DEP jurisdiction has an overall summer demand realization rate of ~~99~~97% because the interactive effects, summer coincidence factors, and verified quantities once again balanced one another out. The ~~99~~97% comes from those interactive effects and coincidence factors having a slightly higher influence on the realization rates than the verified quantities. The jurisdiction's overall winter demand realization rate was ~~98~~96% because the winter demand coincidence factors decreased the Lighting strata's realization rates, producing a slightly lower overall winter

peak realization rate. Figure 3-7 and Figure 3-9 show how the calculation methods impacted DEP's summer and winter realization rate for each stratum, respectively.

Table 3-25 Summer Peak Demand Realization Rates by Strata – DEC

Stratum	ER	ISR	Total Summer Demand Realization Rate (ER +ISR)
Lighting Large	86%~~97%~~	83%~~83%~~	72%~~80%~~
Lighting Medium	86%~~96%~~	100%~~100%~~	86%~~96%~~
Lighting Small	90%~~101%~~	100%~~100%~~	90%~~101%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~100%~~**	**99%~~99%~~**	**97%~~99%~~**

Source: Guidehouse analysis, values subject to rounding.

Table 3-26 Summer Peak Demand Realization Rates by End Use – DEC

Stratum	ER	ISR	Total Summer Demand Realization Rate (ER +ISR)
Lighting	87%~~98%~~	96%~~96%~~	83%~~93%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~100%~~**	**99%~~99%~~**	**97%~~99%~~**

Source: Guidehouse analysis, values subject to rounding.

Table 3-27 Summer Peak Demand Realization Rates by Strata - DEP

Stratum	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting Large	78%~~88%~~	83%~~83%~~	65%~~73%~~
Lighting Medium	86%~~96%~~	100%~~100%~~	85%~~96%~~
Lighting Small	93%~~104%~~	100%~~100%~~	92%~~104%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~99%~~**	**99%~~99%~~**	**97%~~99%~~**

Source: Guidehouse analysis, values subject to rounding.

Table 3-28 Summer Peak Demand Realization Rates by End Use – DEP

End Use	ER	ISR	Total Summer Demand Realization Rate (ER +ISR)
Lighting	86%~~97%~~	96%~~96%~~	83%~~93%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~99%~~**	**99%~~99%~~**	**97%~~99%~~**

Source: Guidehouse analysis, values subject to rounding.

Table 3-29 Winter Peak Demand Realization Rates by Strata – DEC

Stratum	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting Large	89%~~98%~~	83%~~83%~~	74%~~81%~~
Lighting Medium	88%~~97%~~	100%~~100%~~	88%~~97%~~
Lighting Small	84%~~93%~~	100%~~100%~~	84%~~93%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~99%~~**	**99%~~99%~~**	**96%~~98%~~**

Source: Guidehouse analysis, values subject to rounding.

Table 3-30 Winter Peak Demand Realization Rates by End Use – DEC

End Use	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting	87%~~96%~~	96%~~96%~~	83%~~91%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~99%~~**	**99%~~99%~~**	**96%~~98%~~**

Source: Guidehouse analysis, values subject to rounding

Table 3-31 Winter Peak Demand Realization Rates by Strata – DEP

Stratum	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting Large	86%~~94%~~	83%~~83%~~	72%~~79%~~
Lighting Medium	87%~~95%~~	100%~~100%~~	86%~~95%~~
Lighting Small	81%~~91%~~	100%~~100%~~	81%~~90%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~99%~~**	**99%~~99%~~**	**96%~~98%~~**

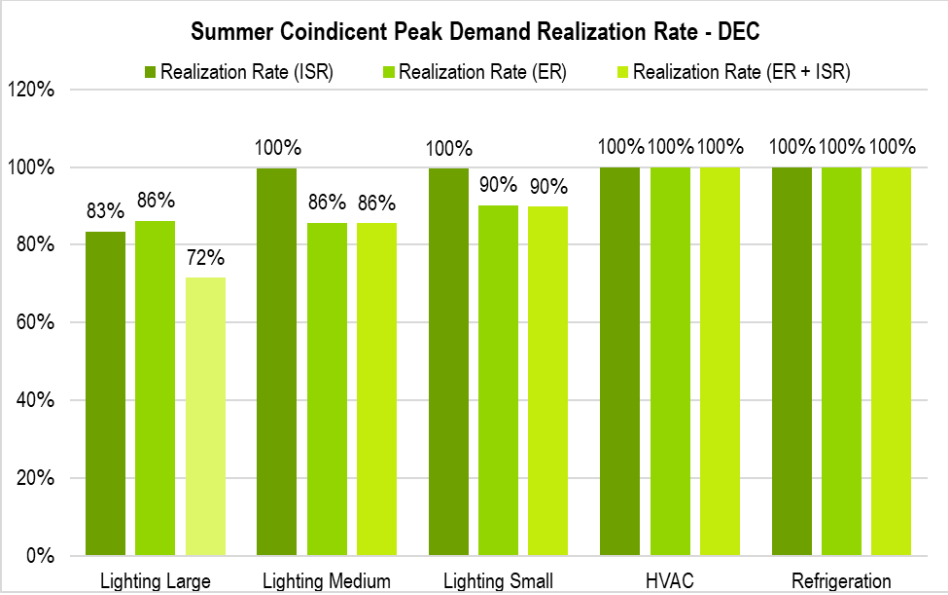
Source: Guidehouse analysis, values subject to rounding.

Table 3-32 Winter Peak Demand Realization Rates by End Use – DEP

End Use	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting	84%~~93%~~	96%~~96%~~	80%~~89%~~
HVAC	100%~~100%~~	100%~~100%~~	100%~~100%~~
Refrigeration	100%~~100%~~	100%~~100%~~	100%~~100%~~
Total	**97%~~99%~~**	**99%~~99%~~**	**96%~~98%~~**

Source: Guidehouse analysis, values subject to rounding

Figure 3-6 Comparison of Summer Peak Demand Savings Realization Rates by Strata – DEC



Source: Guidehouse analysis, values subject to rounding.

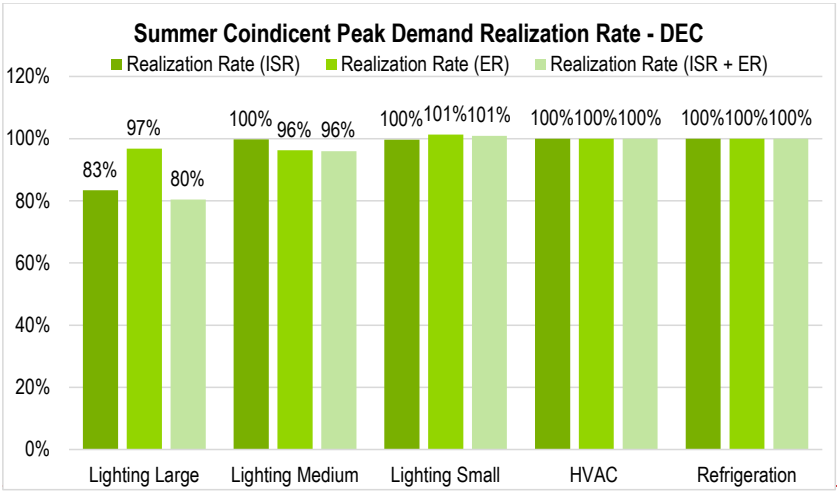
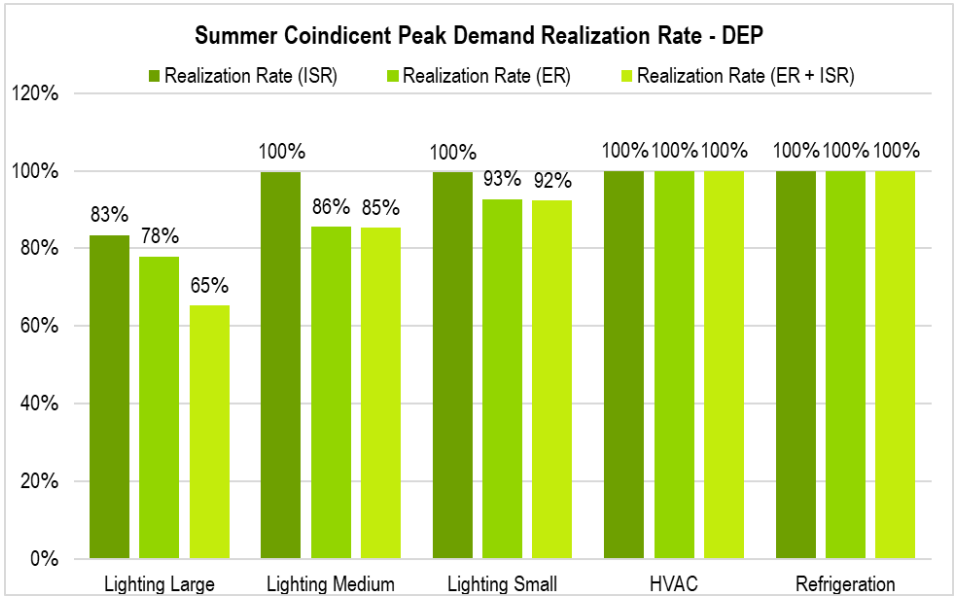
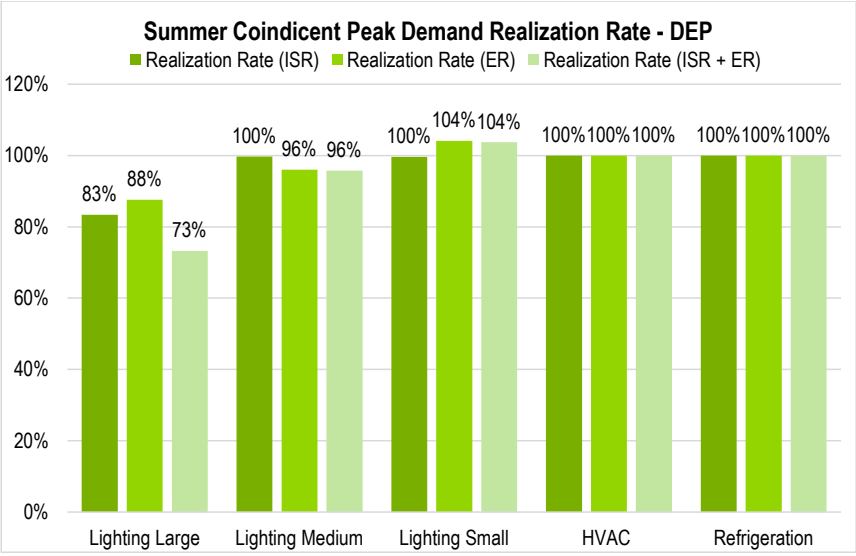


Figure 3-7 Comparison of Summer Peak Demand Savings Realization Rates by Strata – DEP

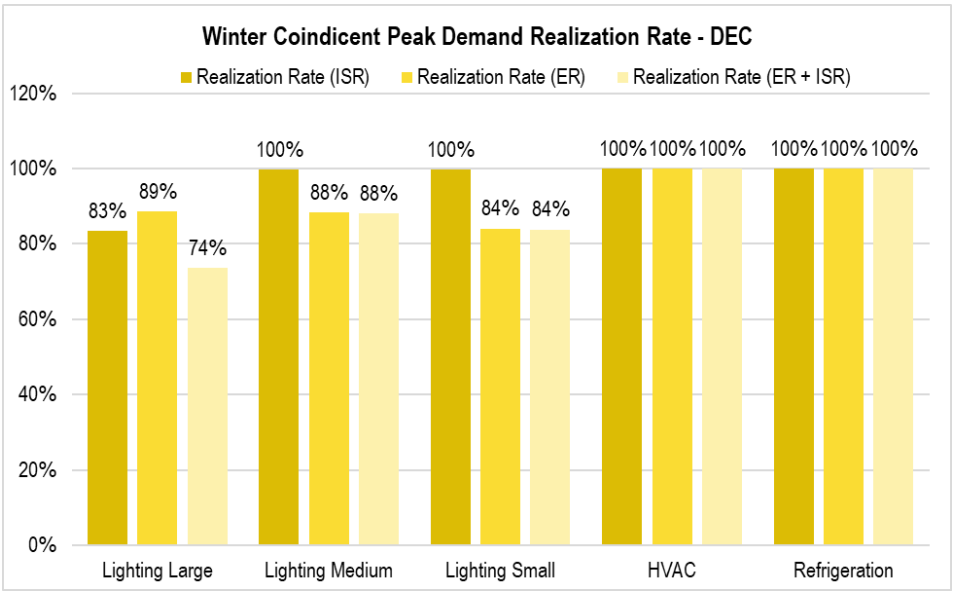


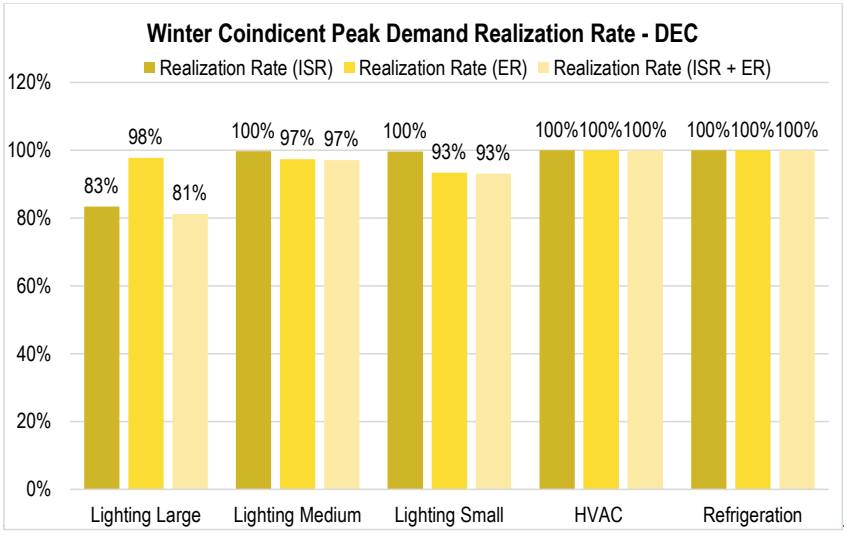
Source: Guidehouse analysis, values subject to rounding.



Source: Guidehouse analysis, values subject to rounding.

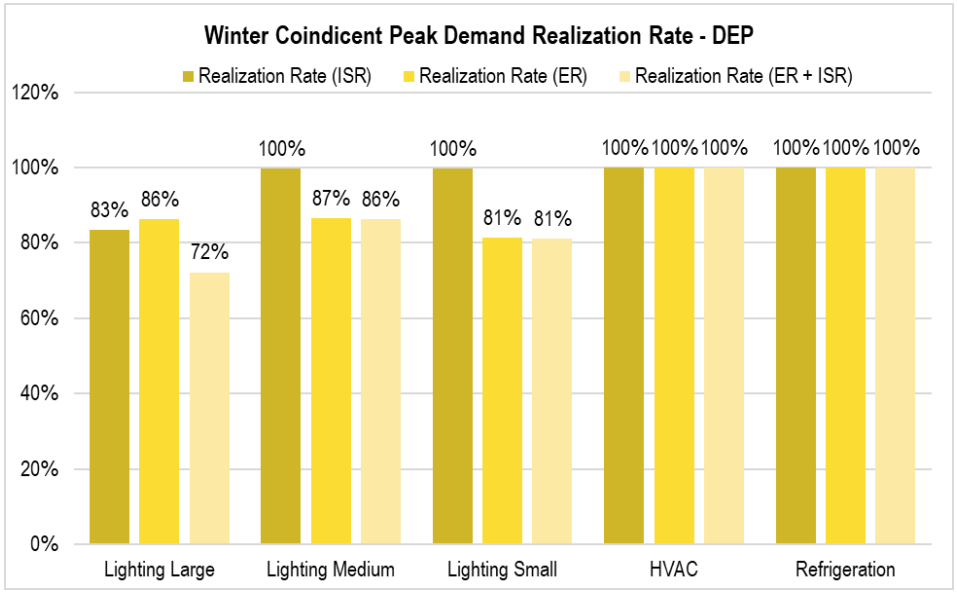
Figure 3-8 Comparison of Winter Peak Demand Savings Realization Rates by Strata – DEC



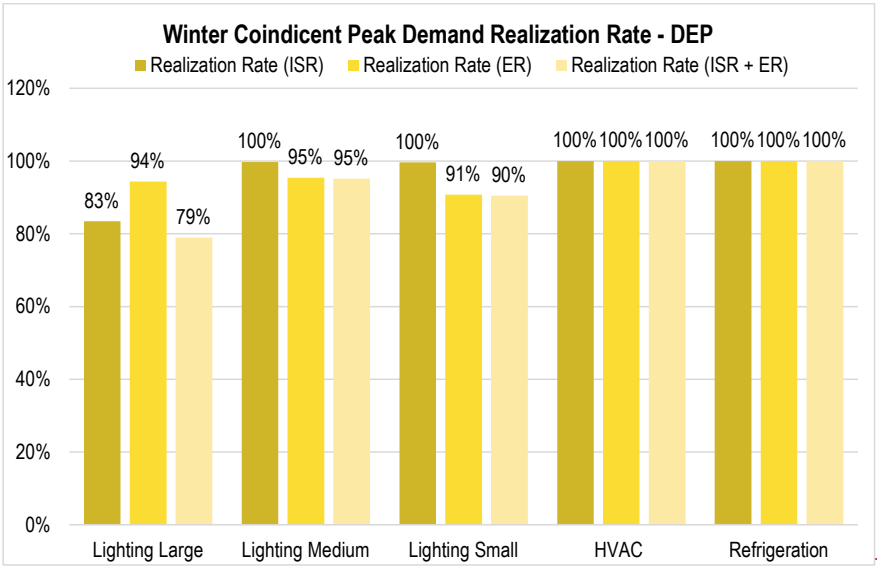


Source: Guidehouse analysis, values subject to rounding.

Figure 3-9 Comparison of Winter Peak Demand Savings Realization Rates by Strata – DEP



Source: Guidehouse analysis, values subject to rounding.



Source: Guidehouse analysis, values subject to rounding.

4. Process Evaluation

The purpose of the process evaluation is to understand, document and provide feedback on the program implementation components and customer experience.

4.1 Process Methodology

The evaluation team conducted in-depth interviews with SBES Program staff and implementation contractor (IC) staff as well as conducting customer participant surveys, as noted previously. The process findings summarized in this document are based on the results of:

- Participant surveys with 97 program participants.
- Program review, including interviews with the Duke Energy Program Manager and the IC staff; and a review of the program documentation.

Due to the COVID-19 pandemic, Guidehouse performed both the impact and process evaluation activities using online survey platforms, rather than prior evaluations where onsite field verification was used for the impact assessment. To accomplish the virtual assessments, Guidehouse randomly divided the population of participants into separate groups to receive invitations for process and impact-related surveys, such that participants would not be inundated with multiple requests. Email addresses were also not available for all participants. The response status of all process survey participants is outlined in Table 4-1.

Table 4-1. Response Status – Process Survey

Status	Number of Responses
Email Failed	325
Email Hard Bounce	11
Email Not Sent	35
Email Opened	1
Email Sent	536
Email Soft Bounce	15
Survey Finished	97
Survey Partially Finished	25
Survey Started	300
Total	**1,345**

Source: Guidehouse

4.2 Participant Survey

Guidehouse designed the surveys to ask specific questions about the program measure categories. The measure families as a part of this evaluation period are lighting, HVAC, and refrigeration. Participants received an email invitation to complete an online survey that was designed to collect detailed information about program experience and satisfaction. The survey

was 15-20 minutes long and participants received an incentive of $10-$40 based on the timing of participation.

The survey effort successfully completed surveys with 97 customers to assess:

- Participation experience and satisfaction
- Participant channel and awareness
- Feedback about program components
- Program improvements
- Program benefits and challenges
- Satisfaction associated with implementation contractors
- Free-ridership, Inside and Outside Spillover

4.3 Program Review

The evaluation team designed the program review task to understand changes and updates to the program design, implementation and energy and demand savings assumptions. Guidehouse reviewed program literature and Duke Energy's website, interviewed the Duke Energy program team, and had several conversations with Lime Energy regarding the energy and demand savings included in the program tracking database. The key program characteristics include the following:

- **Program Design** – The SBES program is designed to offer high incentives (up to 80 percent of the total cost of the project) on efficient equipment to reduce energy use and peak demand. It specifically targets small business customers that are difficult to reach and often do not pursue energy efficiency on their own.
- **Program Implementation** – A third-party contractor, Lime Energy administers the SBES program on Duke Energy's behalf. The IC handles all aspects of the program, including customer recruitment, facility assessments, equipment installation (through independent installers contracted by the IC), and payment and incentive processing. The IC reports energy and peak demand reduction estimates to Duke Energy. The IC has continued to refine their processes to ensure that savings estimates are reasonable and customer complaints are handled in a timely manner.
- **Incentive Model** – The IC offers potential participants a recommended package of energy efficiency measures along with equipment pricing and installation costs. The incentive is proportional to estimated energy savings and can be as high as 80 percent of the total cost of the project.
- **Savings Estimates** – Energy and peak demand savings are estimated on a per-measure basis, considering existing equipment, proposed equipment, and operational characteristics unique to each customer.

4.4 Participant Survey Findings

The following sections detail the process findings from all relevant sources of program information, including interviews with Duke Energy and IC staff and the results of the customer surveys, organized by topic. The feedback received indicates that the SBES Program serves Duke Energy's customers well and represents an important component of Duke Energy's portfolio of business energy efficiency programs. Key findings are as follows:

- A majority of SBES participants were satisfied with the program. On a scale of 0 to 10, where 0 indicates “not satisfied at all” and 10 indicates “extremely satisfied”:
    - 82 percent of respondents indicated 8-10 for satisfaction with overall program experience.
    - 90 percent of respondents indicated 8-10 for satisfaction with Lime Energy
- Sixty-six percent of respondents stated that equipment offered through the program allowed them to upgrade all of the equipment they wanted at the time.
- Eighty-two percent of respondents mentioned that they are extremely likely to participate in this program or a similar Duke Energy program again.
- Sixty-three percent of respondents mentioned that that their attitude towards Duke Energy is more positive after participating in the program.
- Over Fifty percent of respondents stated that they had recommended the program to other businesses. On average, respondents recommended the program to an average of three other businesses.

The following sections details the process findings and addresses the following topics:

1. Overall customer experience.
2. Implementation contractor.
3. Program challenges.
4. Program benefits.
5. Suggested improvements.

4.4.1 Customer Experience

Customers reported very high satisfaction with their overall program experience as shown in Figure 4-1. Only four percent of the participants rated their overall satisfaction as less than 5, and 82% rated their satisfaction as an 8, 9, or 10.

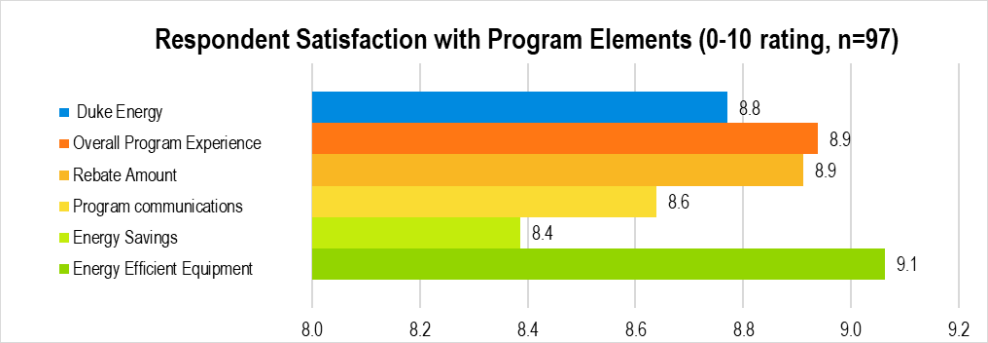
Guidehouse identified some correlations with overall program satisfaction that provide insight into drivers of high satisfaction:

- Customers with overall high program satisfaction were more satisfied on average with every program element, but the difference was particularly noticeable on two program elements:
    - **The energy savings resulting from the new equipment**: highly satisfied customers gave an average rating of 9.4 vs 4.9 among less satisfied customers. Five respondents mentioned that they have not seen any significant savings from the new equipment which is why they provided a lower rating.
    - **Program communications**: highly satisfied customers gave an average rating of 9.4 vs 5.7 among less satisfied customers. Three respondents mentioned that there could be clearer communication between their internal team and Duke Energy.

Around **63%** respondents mentioned that their attitude towards Duke Energy is more positive after participating in the program. These findings indicate both high program satisfaction and an opportunity to continue to market energy efficiency programs to previous participants to achieve deeper savings.

Participation in the SBES program generally served to improve customers' satisfaction with Duke Energy overall.

Figure 4-1. Program Satisfaction (n=97)



Source: Guidehouse analysis

4.4.2 Implementation Contractor

As mentioned in the previous section, customers are highly satisfied with the services provided by the implementation contractor, Lime Energy and that high satisfaction translates to high overall program satisfaction.

Nearly all (97%) said that the proposal was clear about the scope of work to be performed, and 99% of customers said that the proposal was clear about their share of project costs.

A large majority (89%) of customers said they knew who to contact if they had any questions or concerns about their project or any aspect of the program.

Respondents report high level of satisfaction with all different aspects of project implementation from the first assessment of energy efficiency at the project site to post installation clean-up as shown in Figure 4-2. 90% of respondents rated their satisfaction with different aspects of the project implementation at an 8 or higher, on a scale of 0 to 10.

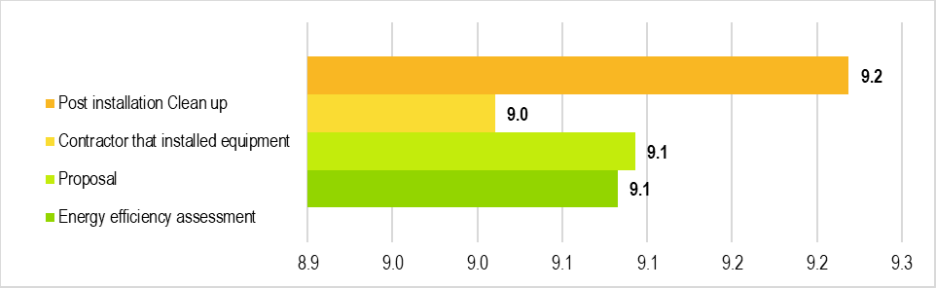
Some verbatim responses from the respondents supporting the high satisfaction:

"The program was excellent and allowed me to afford
the upgrade of lighting in my store. It has cut my monthly bill by every bit of the projection I was given. I am very thankful. Thank you!"

"They worked very well during COVID19 restrictions"

"It was fantastic. I recommended this service to a friend who is also a business owner and he did it as well and was equally thrilled."

Figure 4-2. Implementer and Contractor Satisfaction (n=97)



Source: Guidehouse analysis

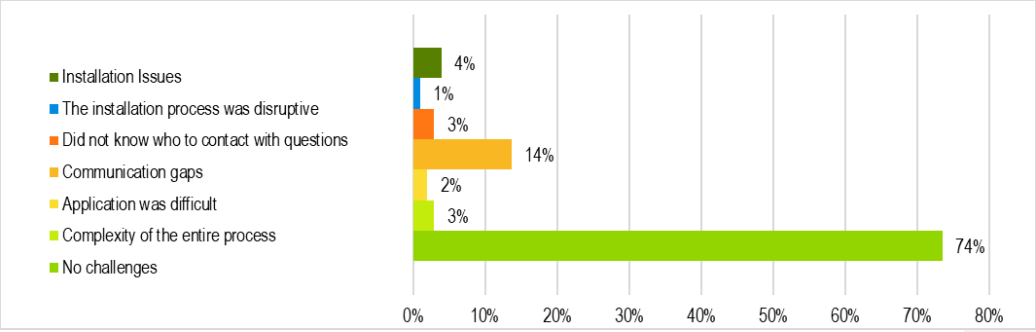
Customers are highly satisfied with the energy efficiency assessment conducted by Lime Energy as well as the proposal prepared by Lime Energy, with 90% rating their satisfaction as an 8 or higher for both program elements.

A similar percentage of customers, 89% rated their satisfaction with the inspection as an 8 or higher with the post installtion cleanup conducted by Lime Energy. Only one customer rated this aspect less than 5 out of 10.

4.4.3 Program Challenges

As seen in Figure 4-3, almost 74% of respondents did not experience any challenges with different program components. Fourteen respondents mentioned that there were communication gaps between Duke Energy, the implementation team and their internal team. Four respondents mentioned that installations of measures was not correct or incomplete. Five respondents mentioned that the application was difficult, and the process was too complex. Only one respondent mentioned that that the installation process was disruptive to their work.

Figure 4-3:Program Challenges/Drawbacks, (n=97)



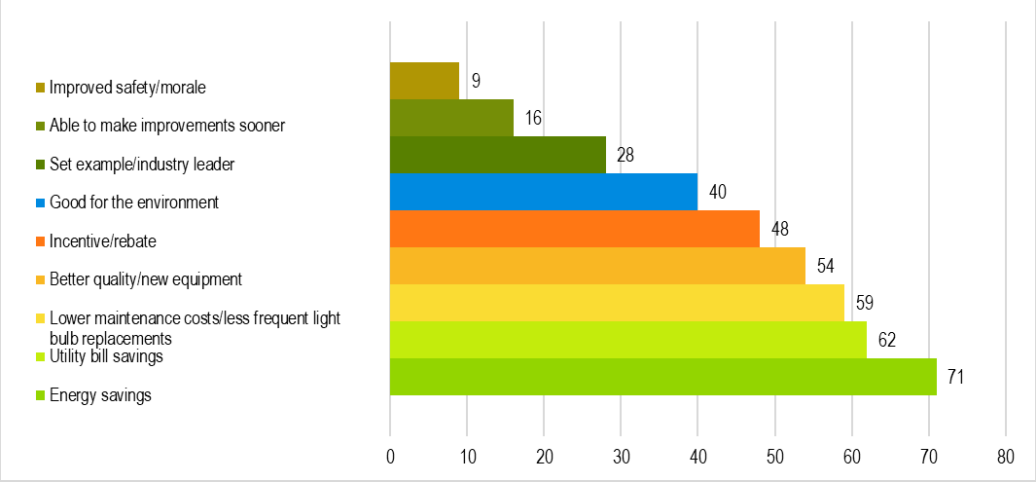
Source: Guidehouse analysis

4.4.4 Program Benefits

As shown in Figure 4-4, a majority of customers identified the energy savings and associated utility bill savings as the top benefit of participating in the SBES program. Better quality equipment and lower maintenance hassle were also significant benefits to many customers. Another important survey finding was that 66 percent of customers stated that the equipment offered through the program allowed them to upgrade all of the equipment they wanted at the time of the project, rather than piecing together the upgrades in multiple phases.

Majority of respondents (82%) mentioned that they are extremely likely to participate in this program or a similar Duke Energy program again.

Figure 4-4:Program Benefits, (n=97)

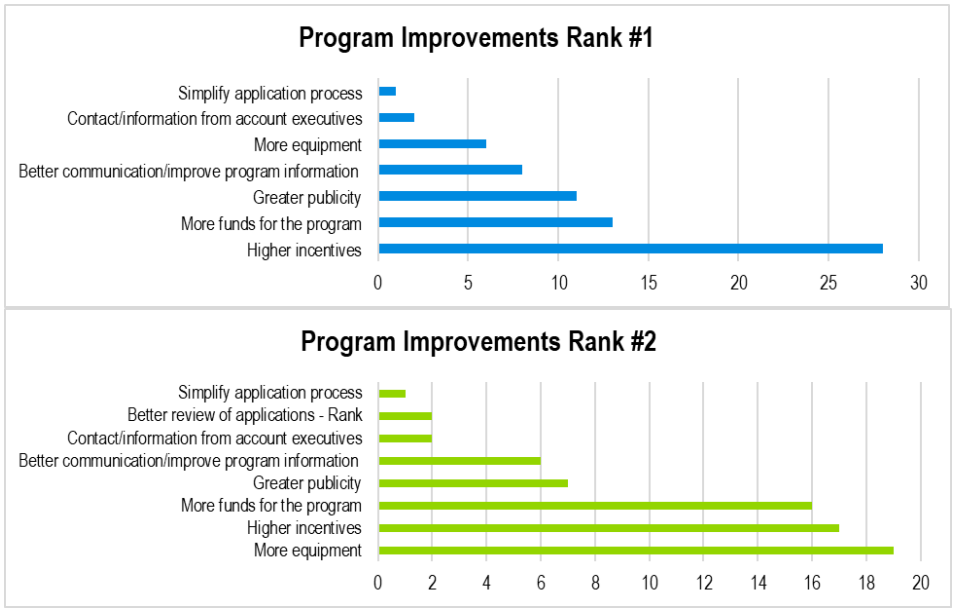


Source: Guidehouse analysis

4.4.5 Suggested Improvements

Overall program satisfaction is very high, but some customers had minor complaints or identified drawbacks of the program. Guidehouse asked respondents to rank the top 3 program improvements they would like to see in future programs. The two charts in Figure 4-5 show the different program improvements and how they were ranked by the respondents. As expected, higher incentive was ranked as the #1 program improvement requested by the majority of the respondents. More choice of equipment/measures and more funds for the program was the second and third highest ranked improvement requested by majority of the respondents.

Figure 4-5:Program Improvements



Source: Guidehouse analysis

5. Net-to-Gross Analysis

The impact analysis described in the preceding sections addresses *gross program savings*, based on program records, modified by an engineering review and virtual verification of measure installations. *Net savings* incorporate the influence of free ridership (savings that would have occurred even in the absence of the program) and spillover (additional savings influenced by the program, but not captured in program records) and are commonly expressed as a NTG ratio applied to the verified gross savings values.

Table 5-1 shows the results of Guidehouse' s NTG analysis. In aggregate, the NTG results are very similar to findings from the prior evaluation.

Table 5-1. 2019-2020 Net-to-Gross Results

	Lighting	Refrigeration	HVAC	Lighting, HVAC & Refrigeration
Estimated Free Ridership	0.06	0.14	0.01	0.06
Estimated Spillover	0.08	0.08	0.06	0.07
Estimated NTG	**1.02**	**0.94**	**1.05**	**1.02**

Source: Guidehouse analysis, totals subject to rounding.

This report provides definitions, methods, and further detail on the analysis and findings of the net savings assessment. The discussion is divided into the following three sections:

- Defining free ridership, spillover, and net-to-gross (NTG) ratio
- Methods for estimating free ridership and spillover
- Results for free ridership, spillover, and NTG ratio

5.1 Defining Free Ridership, Spillover, and Net-to-Gross Ratio

The methodology for assessing the energy savings attributable to a program is based on a NTG ratio. The NTG ratio has two main components: free ridership and spillover.

Free ridership is the share of the gross savings that is due to actions participants would have taken even in the absence of the program (i.e., actions that the program did not induce). This is meant to account for naturally occurring adoption of energy efficient technology. The SBES program covers a range of energy efficient lighting and refrigeration measures and is designed to move the overall market for energy efficiency forward. However, it is likely that some participants would have wanted to install, for various reasons, some high efficiency equipment (possibly a subset of those installed under the SBES Program), even if they had not participated in the program or been influenced by the program in any way.

Spillover captures program savings that go beyond the measures installed through the program. Spillover adds to a program's measured savings by incorporating indirect (i.e., non-incentivized) savings and effects that the program has had on the market above and beyond the directly incentivized or directly induced program measures.

Total spillover is a combination of non-reported actions to be taken at the project site itself (*within-facility spillover*) and at other sites (*outside-facility spillover*). Each type of spillover is meant to capture a different aspect of the energy savings caused by the program, but not included in program records.

The **overall NTG ratio** accounts for both the net savings at participating projects and spillover savings that result from the program but are not included in the program's accounting of energy savings. When the NTG ratio is multiplied by the estimated gross program savings, the result is an estimate of energy savings that are attributable to the program (i.e., savings that would not have occurred without the program).

The basic equation is shown in Equation 1.

Equation 1. Net-to-Gross Ratio

$$NTG = 1 - Free\ Ridership + Spillover$$

The underlying concept inherent in the application of the NTG formula is that *only* savings caused by the program should be included in the final net program savings estimate but that this estimate should include *all* savings caused by the program.

5.2 Methods for Estimating Free Ridership and Spillover

5.2.1 Estimating Free Ridership

Data to assess free ridership were gathered through the self-report method—a series of survey questions asked of SBES participants. Free ridership was asked in both direct questions, which aimed at obtaining respondent estimates of the appropriate free ridership rate that should be applied to them, and in supporting or influencing questions, which could be used to verify whether the direct responses are consistent with participants' views of the program's influence.

Respondents were asked three categories of program-influence questions:

- **Likelihood:** to estimate the likelihood that they would have incorporated lighting measures "of the same high level of efficiency," if not for the assistance of the SBES Program. In cases where respondents indicated that they might have incorporated some, but not all, of the measures, they were asked to estimate the share of measures that would have been incorporated anyway at high efficiency. This flexibility in how respondents could conceptualize and convey their views on free ridership allowed respondents to give their most informed response, thus improving the accuracy of the free-ridership estimates.
- **Prior planning:** to further estimate the probability that a participant would have implemented the measures without the program. Participants were asked the extent to which they had considered installing the same level of energy-efficient lighting prior to participating in the program. The general approach holds that if customers were not definitively planning to install all of the efficiency lighting prior to participation, then the program can reasonably be credited with at least a portion of the energy savings resulting from the high-efficiency lighting. Strong free ridership is reflected by those participants who indicated they had already allocated funds for the purchase and selected the lighting and an installer.

- **Program importance:** to clarify the role that program components (e.g., information, incentives) played in decision-making, and to provide supporting information on free ridership. Responses to these questions were analyzed for each respondent, not just in aggregate, and were used to identify whether the direct responses on free ridership were consistent with how each respondent rated the "influence" of the program.

Free-ridership scores were calculated for each of these categories[6] and then averaged and divided by 100 to convert the scores into a free-ridership percentage. Next, a timing multiplier was applied to the average of the three scores to reflect the fact that respondents indicating that their energy efficiency actions would not have occurred until far into the future may be overestimating their level of free ridership. Participants were asked, without the program, when they would have installed the equipment. Respondents who indicated that they would not have installed the lighting for at least two years were not considered free riders and had a timing multiplier of 0. If they would have installed at the same time as they did, they had a timing multiplier of 1; within one year, 0.67; and between one and two years, 0.33. Participants were also asked when they learned about the financial incentive; if they learned about it after the equipment was installed, then they had a free ridership ratio of 1.

5.2.2 Estimating Spillover

The basic method for assessing participant spillover (both within-facility and outside-facility) was an approach that asked a set of questions to determine the following:

- **Whether spillover exists at all.** These were yes/no questions that asked, for example, whether the respondent incorporated energy efficiency measures or designs that were not recorded in program records. Questions related to extra measures installed at the project site (within-facility spillover) and to measures installed in non-program projects (outside-facility spillover) within the service territory.
- **The share of those savings that could be attributed to the influence of the program.** Participants were asked if they could estimate the energy savings from these additional extra measures to be less than, similar to, or more than the energy savings from the SBES program equipment.

[6] Scores were calculated by the following formulas:

» Likelihood: The likelihood score is 0 for those that "definitely would NOT have installed the same energy efficient measure" and 1 for those that "definitely WOULD have installed the same energy efficient measure." For those that "MAY HAVE installed the same energy efficient measure," the likelihood score is their answer to the following question: "On a scale of 0 to 10 where 0 is DEFINITELY WOULD NOT have installed and 10 is DEFINITELY WOULD have installed the same energy efficient measure, can you tell me the likelihood that you would have installed the same energy efficient measure?" If more than one measure was installed in the project, then this score was also multiplied by the respondent's answer to what share they would have done.

» Prior planning: If participants stated they had considered installing the measure prior to program participation, then the prior planning score is the average of their answers to the following two questions: "On a scale of 0 to 10, where 0 means you 'Had not yet planned for equipment and installation' and 10 means you 'Had identified and selected specific equipment and the contractor to install it', please tell me how far along your plans were" and "On a scale of 0 to 10, where 0 means 'Had not yet budgeted or considered payment' and 10 means 'Already had sufficient funds budgeted and approved for purchase', please tell me how far along your budget had been planned and approved."

» Program importance: This score was calculated by taking the maximum importance on a 0 to 10 scale of the four program importance questions and subtracting from 10 (i.e., the higher the program importance, the lower the influence on free ridership).

- **Program importance.** Estimates were derived from a question asking the program importance, on a 0 to 10 scale. Participants were also asked how the program influenced their decisions to incorporate additional energy efficiency measures.

If respondents said no, they did not install additional measures, they received a zero score for spillover. If they said yes, then the individual's spillover was estimated as the self-reported savings as a share of project savings, multiplied by the program-influence score. Then, a 50 percent discount was applied to reflect uncertainty in the self-reported savings and divided by 10 to convert the score to a spillover percentage.

5.2.3 Combining Results across Respondents

The evaluation team determined free ridership and spillover estimates for each of the following:

- Individual respondents, by evaluating the responses to the relevant questions and applying the rules-based approach discussed above
- Measure categories:
    - For free ridership: by taking the average of each respondent's score within each category, weighted by the respondent's share of savings within the measure category
    - For spillover: by taking the sum of the individual spillover results (in kWh) for each measure category and dividing by the category's total program savings in the sample
- The program as a whole, by combining measure-level results:
    - For free ridership: measure category results were subsequently weighted by each category's share of total program savings
    - For spillover: similarly, measure category results were subsequently weighted by each category's share of total program savings

5.3 Results for Free Ridership, Spillover, and Net-to-Gross

This section presents the results of the attribution analysis for the SBES Program. Specifically, results are presented for free ridership and spillover (within-facility and outside-facility), which are used collectively to calculate an NTG ratio.

5.3.1 Review of Data Collection Efforts for Attribution Analysis

Guidehouse conducted 96[7] surveys with SBES participants to estimate free ridership, spillover, and NTG ratios. Table 5-2 shows the number of completions, by measure group.

Table 5-2. Participant Survey Completes by Project Type

Measure Category	Surveys
Lighting	64
Refrigeration	16
HVAC	16
Total	**96**

Source: Guidehouse analysis

5.3.2 Free-Ridership Results

Guidehouse asked participants a series of questions regarding the likelihood, scope, and timing of the investments in energy-efficient lighting if the respondent had not participated in the program. The purpose of the surveys was to elicit explicit estimates of free ridership and perspectives on the influence of the program. Guidehouse estimates free-ridership for the SBES Program at six percent of program-reported savings.

Guidehouse developed the free ridership estimate presented above based on responses to a variety of questions that related to survey respondents' intentions prior to participating in the program and to the influence of the program itself. Below are summaries by scoring component.

Prior Planning: Fifty out of 96 respondents indicated they had **prior plans to install energy efficient** equipment at their facilities before participating in the program. However, only 12 of the 50 respondents indicated their plans were **well-developed** (7 or higher on a scale of 0 to 10) in terms of identifying equipment for installation and 9 out of 28 respondents had budgeted for installing the equipment.

Program Importance: Respondents provided an average rating of 9 out of 10 for how important the financial incentive offered through the SBES program was in **influencing their decision** to upgrade their equipment.

Likelihood: Respondents were asked in the absence of the program, if they would have had at least some of the work done (in terms of both quantity of measures and the efficiency of measures installed). Five respondents indicated they would have installed about **32%** of the same energy efficiency equipment in the absence of the program.

Timing: Without the program, 29 respondents said that they would have installed the measures at the **same time or within 1-2 years, and the remainder would have delayed longer**.

[7]The survey was combined with process and NTG sections. One respondent did not complete the NTG section of the combined survey.

5.3.3 Spillover Results

The SBES Program influenced approximately five percent of participants to install additional energy efficiency measures on-site and influenced two percent of participants to install additional measures at other locations. Based on the survey findings, the evaluation team estimates the overall program spillover to be seven percent of program-reported savings. Participants reported a variety of spillover measures installed, including lighting (most common) and HVAC.

5.3.3.1 Inside Spillover

Table 5-3 shows the inside (within facility) spillover by measure type. The inside spillover for the program was estimated at **six** percent.

Program Importance: 32 out of 96 respondents indicated the program influenced them to install additional measures or change their behavior to be more energy efficient.

Qualified for Spillover: 19 out of the 32 respondents qualified for inside spillover based on information provided.

Spillover Savings Measures: Most respondents indicated retrofits to LED lights but a select few upgraded HVAC equipment like ductless mini split heat pumps and packaged HVAC units due to the program's influence. Their main rationale for not applying for an incentive was lack of awareness of incentives through the program or the measures not qualifying for an incentive through the program.

Table 5-3. Inside Spillover by Measure Type

Measure Family	Inside Spillover
Lighting	5.5%
Refrigeration	7.9%
HVAC	6.0%
Total	**5.7%**

Source: Guidehouse analysis, totals subject to rounding

5.3.3.2 Outside Spillover

Table 5-4 shows the outside (outside facility) spillover by measure type. The outside spillover for the program was estimated at two percent.

Program Importance: Only ten out of 97 respondents indicated the program influenced them to install additional measures or change their behavior to be more energy efficient, but the resulting impacts were relatively small.

Qualified for Spillover: Only five out of the ten respondents qualified for outside spillover based on information provided**.**

Spillover Savings Measures: All respondents contributing to spillover indicated retrofits to LEDs due to the program's influence. Their main rationale for not applying for an incentive was lack of awareness of incentives through the program or the measures not qualifying for an incentive through the program.

Table 5-4. Outside Spillover by Measure Type

Measure Family	Outside Spillover
Lighting	2.3%
Refrigeration	0.0%
HVAC	0.0%
Total	**2.0%**

Source: Guidehouse analysis, totals subject to rounding

5.3.3.3 Total Spillover

Total spillover is the sum of inside and outside spillover. Adding the result of 5.4% for inside spillover and 2.0% for outside spillover, Guidehouse found a total spillover of 7.4%.

5.3.4 Net-to-Gross Ratio

As stated above, the NTG ratio is defined as follows in Equation 2 below.

Equation 2. Net-to-Gross Ratio

$$NTG = 1 - free\ ridership + spillover$$

Using the overall free ridership value of two percent and the overall spillover value of nine percent, the NTG ratio is 1 – 0.06 + 0.07 = 1.02[8]. The estimated NTG ratio of 1.02 implies that for every 100 megawatt-hours (MWh) of realized savings recorded in SBES records, 102 MWh is attributable to the program. Table 5-5 shows the final NTG results.

Table 5-5. SBES Free Ridership, Spillover, and NTG Ratio

	Free Ridership	Spillover	NTG Ratio
SBES Program Total	0.06	0.07	1.02

Source: Guidehouse analysis, totals subject to rounding.

Table 5-6 and Table 5-7 shows the verified net savings after applying the impact realization rate as well as the NTG ratio for energy and demand savings DEC and DEP respectively.

[8] The total is subject to rounding. The weighted average calculation of the overall NTG value is causing the rounding error.

Table 5-6. DEC SBES Reported, Verified Gross and Verified Net Savings

Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	68,413	80,343	80,343
Realization Rate	92%~~100%~~	97%~~99%~~	96%~~98%~~
Verified Gross Savings	62,613~~68,738~~	77,601~~79,256~~	77,523~~78,936~~
Net-to-Gross	102%	102%	102%
Verified Net savings	63,865~~70,113~~	79,153~~80,841~~	79,074~~80,515~~

Source: Guidehouse analysis, totals subject to rounding.

Table 5-7. DEP SBES Reported, Verified Gross and Verified Net Savings

Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	46,571	51,433	51,433
Realization Rate	92%~~101%~~	97%~~99%~~	96%~~98%~~
Verified Gross Savings	42,852~~46,889~~	49,640~~50,696~~	49,383~~50,267~~
Net-to-Gross	102%	102%	102%
Verified Net savings	43,709~~47,827~~	50,633~~51,710~~	50,370~~51,272~~

Source: Guidehouse analysis, totals subject to rounding.

6. Conclusions and Recommendations

Guidehouse' s findings suggest that Duke Energy's SBES program is being delivered and tracked effectively in the DEC and DEP jurisdictions. Customer satisfaction is generally high, and the program measure installations appear to be tracked appropriately. Guidehouse presents the following list of recommendations to help improve program delivery and impacts:

1. **Consider introducing additional equipment choices in the program.** A subset of customers reported that the program was unable to provide all the energy efficiency equipment they wanted. Duke Energy should consider introducing more equipment choices in the program to include outdoor lighting and HVAC measures. This also presents an opportunity for channeling to other Duke Energy programs or education about measures that are not offered through the SBES program.
2. **Increase and improve program communications.** This is the most common challenge or drawback received from participants, indicating that customers were sometimes unclear about the various stages of the program process and did not receive proper communication and guidance from the implementer and/or Duke Energy. Additional education from both Lime Energy and Duke Energy account managers should help customers better understand the program participation process.
3. **Consider using TRM algorithms for HVAC measures.** Lime Energy and Duke Energy developed deemed savings estimates using regional data for HVAC measures. Although the methodology for developing these estimates was accurate, Guidehouse recommends Duke Energy consider using TRM algorithms too and substituting the variables in these algorithms using regional values to estimate savings. This may enhance the transparency of the impact estimates for these measures.
4. **The Program Net-to-Gross Ratio is high**. This indicates that the program is providing a key service to small business customers in helping them manage their energy use.

7. Summary Form

Small Business Energy Saver

Completed EMV Fact Sheet

Description of program

Duke Energy's Small Business Energy Saver Program provides energy efficient equipment to eligible small business customer at up to an 80 percent discount. The program is delivered through an implementation contractor that coordinates all aspects of the program, from the initial audit, ordering equipment, coordinating installation, and invoicing.
The program consists of lighting, HVAC, and refrigeration measures.

- **Lighting measures:** LED lamps and fixtures, LED exit signs, occupancy sensors.
- **Refrigeration measures:** LED case lighting, EC motor upgrades, anti-sweat heater controls,
- **HVAC Measures:** HVAC controls, thermostats, and tune-ups

Evaluation Methodology

The evaluation team used engineering analysis and virtual impact assessments as the primary basis for estimating program impacts. Additionally, online surveys were conducted with participants to assess customer satisfaction and determine a net-to-gross ratio.

Impact Evaluation Details

- **Virtual verification surveys were completed by 90 participants.** Guidehouse designed the virtual impact assessment survey tool to collect data about project and measure characteristics for comparison to tracking records and for engineering analysis.
- **In-Service rates (ISRs) varied by equipment type.** The evaluation team found ISRs ranging from 0.29 to 1.00 depending on the equipment type.
- **Participants achieved an average of 35 MWh and 29 MWh of energy savings per year for DEC and DEO respectively.** The program is accurately characterizing energy and demand impacts.

Date	July 07, 2021
Region(s)	Duke Energy Progress Duke Energy Carolinas
Evaluation Period	DEC 1/1/2019 – 6/30/2020 DEP 1/1/2019 – 6/30/2020
Annual net MWh Savings	DEC 70,113 MWh DEP 47,827 MWh
Per Participant net MWh Savings	DEC 34.83 MWh DEP 29.41 MWh
Coincident MW Impact	DEC 79.25MW DEP 50.69 MW
Net-to-Gross Ratio	1.02
Previous Evaluation(s)	2016, 2015, 2014, 2013

8. Measure Level Inputs for Duke Energy Analytics

The SBES program estimates deemed savings on a per-fixture basis that takes into account specific operational characteristics. This approach differs from a more traditional prescriptive approach that applies deemed parameters by measure type and building type.

For the lighting measures, the EM&V team applied HVAC interactive effects and coincident factors in the analysis that differed from those used by the IC; the values used are shown in Table 8-1, Table 8-2 and Table 8-3. Note that for this evaluation the EM&V team applied the coincidence factors for both summer and winter peak demand reductions by lamp type from the logger data analysis completed in 2016. For lighting controls, these values were taken from the NEEP Mid-Atlantic TRM, v10[9].

Table 8-1 HVAC Interactive Effects Multipliers from the NEEP Mid-Atlantic TRM[10]

Building Type	WHFe	WHFd
Office	0.971.10	1.211.36
Retail	0.951.06	1.131.27
School	0.961.10	1.281.44
Warehouse	0.891.02	1.101.23
Other	0.951.08	1.201.35

Source: NEEP Mid-Atlantic TRM, V10

Table 8-2 Summer and Winter Coincidence Factors for Lighting Measures from DEC-DEP 2016 Logger Analysis

Measure	Summer Coincidence Factor	Winter Coincidence Factor
LED Exit Sign	1	1
A Line Lamp	0.914	0.931
Recessed Light	0.914	0.931
Specialty Light	0.914	0.931
LED Tube	0.802	0.619
High/low Bay	1	1
Delamping	0.902	0.664
Exterior Light	0	1

Source: DEC-DEP 2016 logger data analysis.

[9]NEEP TRM (April 2020, v10), https://neep.org/sites/default/files/media-files/trmv10.pdf

[10] The TRM interactive factors are weighted by the heating system fuel type multipliers derived from the participant virtual verification survey.

Table 8-3 Coincidence Factors for Lighting Controls from the NEEP Mid-Atlantic TRM

Building Type	Coincidence Factor
Office	0.70
Retail	0.83
School	0.35
Warehouse	0.80
Other	0.62

Source: NEEP Mid-Atlantic TRM, V10

Additionally, the Duke Energy DSMore table is embedded below for reference.

Appendix A. Process and NTG Survey Guide

DEC/DEP Small Business Energy Saver (SBES) Program
Commercial & Industrial (C&I)

Introduction and Confirmation

Guidehouse is evaluating Duke Energy's Small Business Energy Saver program, and our records show your business participated in this program during this past one or two years. This survey will help Duke Energy better understand the experience and impacts this program had on your business . Your responses are completely confidential.

Landing Page

Thank you for your willingness to complete this survey! Before you get started, just a few notes:

- This survey will ask about your experience with Duke Energy's Small Business Energy Saver program and the different type of energy efficiency equipment installed in your business.
- We are offering a $10 e-gift card for completing the survey. This gift card will be emailed to you within two weeks of completing the survey.

S1. Thanks in advance for your time. Our records indicate your business received **[INSERT SAMPLE_MEASURE_FAMILY]** from the Small Business Energy Saver program on [INSERT INSTALLDATE) , at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**. Is this correct?

Yes	1 **[SKIP TO S3]**
No	2 **[CONTINUE]**
Don't know	3 **[CONTINUE]**

S1a. Is there anyone available who might know about your company's participation in the program and the energy efficiency **[INSERT SAMPLE_MEASURE_FAMILY]** done at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**?

Yes	1 **[CONTINUE]**
No	2 **[THANK AND TERMINATE]**

S2. Can you provide an email address for that person?

Yes, Please enter email address	1 **[GO BACK TO S1]**
No	2 **[THANK AND TERMINATE]**
Don't know	3 **[THANK AND TERMINATE]**

[FOR TERMINATIONS]: These are all the questions we have for you. Thank you for your time.

S3. Our records show that you had the following energy efficiency improvements installed AT THIS SITE: **[INSERT SAMPLE_MEASURE(S)]**. Is this correct?

Yes 1 **[GO TO S4]**

No 2 **[GO TO S3a]**

Don't know 3 **[THANK AND TERMINATE]**

S3a. Was any other energy efficiency equipment installed at this site?

Yes 1 **[GO TO S3b]**

No 2 **[THANK AND TERMINATE]**

Don't know 3 **[THANK AND TERMINATE]**

[FOR TERMINATIONS. These are all the questions we have for you. Thank you for your time.

S3b. Please tell me what energy efficiency equipment was installed at your facility through the DUKE ENERGY program

_____**[OPEN END]**

For the purposes of this survey, the questions will focus on just the **[INSERT MEASURE_FAMILY] which you had installed and not the other measures, and we will just refer to them as "energy efficient equipment."**

S4. How did you learn about the Small Business Energy Saver program? (LIST OPTIONS; ACCEPT MULTIPLE RESPONSES.)

Contacted by my DUKE ENERGY account representative or other DUKE ENERGY staff 1

I contacted my DUKE ENERGY account representative to find out about possible programs 2

Contacted by a LIME ENERGY representative 3

Contacted by a trade ally, vendor, or contractor 4

Energy efficiency conference or workshop 5

Advertising by vendor or contactor 6

Word of mouth through a business colleague 7

Word of mouth through a family, friend, or neighbor 8

Through a trade organization or professional organization/association 9

Mailer or other print materials sent by the program 10

At a trade show 11
Participation in other DUKE ENERGY programs 12
Internet research/DUKE ENERGY website.....13
Social media/online ad 14
Duke Energy call center 15
Email/e-newsletter from Duke Energy.....16
Print material/flyer dropped off at my business 17
Other (Please specify).....18
Don't know 19

S5. Prior to participating in the Small Business Energy Saver program, what concerns did you have about participation, if any?

Cost of project 1
Access to financing/loan for project 2
Disruption to business during installation..... 3
Quality/performance of new equipment 4
Other (Please specify)..... 5
Don't know 6

Contractor and Proposal Module

The next few questions will be about your experiences with the program implementer, Lime Energy, and the equipment installer.

CP1. On a scale of 0 to 10, with 0 being "Not at all satisfied" and 10 being "Extremely satisfied", how satisfied would you say you are with …? [MATRIX STYLE QUESTION]

Items	Not at all satisfied (0)	1	2	3	4	5	6	7	8	9	Completely satisfied (10)	Don't know
CP1a. The energy efficiency assessment conducted by Lime Energy at your business site												
CP1b. The proposal prepared for you by Lime Energy												

CP2. Was the proposal clear about the scope of work to be performed?

Yes 1 **[SKIP TO CP3]**

No 2

Don't know ....3 **[SKIP TO CP3]**

CP2a. Why not?

_____**[OPEN END]**

CP3. Was the proposal clear about your share of the project's final cost?

Yes 1

No 2

Don't know 3

CP4. If you had any questions or concerns about any aspect of your project or the DUKE ENERGY program, did you know who to contact?

Yes 1

No 2

Don't know 3

CP5. On a scale of 0 to 10, with 0 being "Not at all satisfied" and 10 being "Extremely satisfied", how satisfied would you say you are with …? [MATRIX STYLE QUESTION]

Items	Not at all satisfied (0)	1	2	3	4	5	6	7	8	9	Completely satisfied (10)	Don't know
CP5a. The contractor that installed the equipment												
CP5b. The post-installation cleanup												

CP6. Do you have any comments to share, good or bad, about the installation contractor or the post-installation cleanup?

_____**[OPEN END]**

Net to Gross Module

Next are questions relating to your decision to purchase energy efficient equipment for this site.

Free Ridership/Prior Plans

P1. Prior to participating in the program, had you considered installing energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Yes	1
No	2 **[SKIP TO RC1]**
Don't know	3

P1a. Please describe any plans that you had to install the efficient **[INSERT SAMPLE_MEASURE_FAMILY]** prior to participating in the program.

_____**[OPEN END]**

P2a. Again, please think about before your involvement with the program. On a scale of 0 to 10, where 0 means you "Had not yet planned for equipment and installation" and 10 means you "Had identified and selected specific equipment and the contractor to install it", please tell me how far along your plans were.

Had not yet planned for equipment and installation										Identified and selected specific equipment and the contractor to install it	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

P2b. Still thinking about your plans prior to program participation, on a scale of 0 to 10, where 0 means "Had not yet budgeted or considered payment" and 10 means "Already had

sufficient funds budgeted and approved for purchase", please tell me how far along your budget had been planned and approved?

Had not yet budgeted or considered payment										Already had sufficient funds budgeted and approved for purchase
0	1	2	3	4	5	6	7	8	9	10

Role of Contractor

RC1. Did Lime Energy help you with your choice of the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]** equipment installed?
Yes 1
No ..... 2 **[SKIP TO IC1]**
Don't know ..... 3**[SKIP TO IC1]**

RC1a. On a scale of 0 to 10, where 0 is "Not at all important" and 10 is "Extremely important," how important was the recommendation from Lime Energy in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

Importance: Categories

IC1. Please tell me in your own words how the program influenced your decision to install the energy-efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?
_____**[OPEN END]**

Now I want to ask you a few questions about the importance of two different elements of the program to your decision to install the new equipment. Both questions ask you to rate the importance using a 0 to 10 scale where 0 means "Not at all important" and 10 means "Extremely important".

IC2. How important was the program's financial incentive or project discount in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

IC3. How important were the program's advertising and information resources (including the energy efficiency assessment itself) in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

Likelihood

[IF SAMPLE_MEASURE_FAMILY = "Lighting" THEN ASK L1, ELSE SKIP TO L2.]

L1. Given everything you've just said about the program, what is the likelihood that you **would have installed the same energy-efficient lighting** (in the same quantity and the same level of efficiency) without the program and its financial and technical assistance.

Definitely would NOT have installed the same energy efficient lighting.....1

MAY HAVE installed the same energy efficient lighting, even without the program 2

Definitely WOULD have installed the same energy efficient lighting anyway 3

Don't know 4

[IF L1 = 2, 3, or 4, CONTINUE. OTHERWISE, SKIP TO IO1.]

L1a. As best you can, please estimate the percent of the Lighting you think you would have installed at the same high level of efficiency had the program not been available. (USE "998" FOR DON'T KNOW.)

___ % **[RECORD 0-100 OR 998 FOR DON'T KNOW]**

[IF SAMPLE_MEASURE_FAMILY = "Refrigeration" THEN ASK L2, OTHERWISE, SKIP TO IO1.]

L2. Given everything you've just said about the program, on a scale of 0 to 10 where 0 is definitely would not have installed and 10 is definitely would have installed, what is the likelihood that you would have installed the same energy-efficient **[INSERT SAMPLE_MEASURE_FAMILY]** equipment had the program not been available?

_____ **[RECORD 0-10 OR 98 FOR DON'T KNOW]**

[IF SAMPLE_MEASURE_FAMILY = "HVAC and Refrigeration" THEN ASK L3, OTHERWISE, SKIP TO IO1.]

L3. Given everything you've just said about the program, on a scale of 0 to 10 where 0 is definitely would not have installed and 10 is definitely would have installed, what is the likelihood that you would have installed the same energy-efficient **[INSERT SAMPLE_MEASURE_FAMILY]** equipment had the program not been available?

_____ **[RECORD 0-10 OR 98 FOR DON'T KNOW]**

Importance: Overall

IO1. Given everything you've just told me about the program, please tell me how important the program was in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY] equipment**? Please use a 0 to 10 scale where 0 is "Not at all important" and 10 is "Extremely important".

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

Timing

T1. Without the program, when would you have installed the efficient **[INSERT SAMPLE_MEASURE_FAMILY]**? Would it have been…(READ LIST)?

At the same time as you did 1

Within 1 year of the time you did 2

Between 1 and 2 years 3

Sometime after 2 years 4

Would have never installed without the program 5

Spillover (Inside Spillover)

Now we have a few questions concerning any **non-incentivized equipment** you may have also installed at this location.

IS1. Did your experience with the program in any way influence you to incorporate additional energy efficiency equipment where you did not receive a program incentive at this site?

Yes 1 **[CONTINUE]**

No 2 **[SKIP TO OS1]**

Don't know 3 **[SKIP TO OS1]**

IS2. Please briefly describe how the program has influenced your decisions to incorporate additional energy efficiency equipment that were not part of a program incentive.

_____ **[OPEN END]**

IS3. On a scale of 0 to 10, where 0 is "Not at all important" and 10 is "Extremely important", how important was your participation in the program in your decision to install additional energy efficiency equipment?

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

[IF IS3 >5, CONTINUE, ELSE SKIP TO OS1]

IS4. What type of energy-efficient equipment did you install without program incentives, and what were the approximate quantities and project costs? Estimates are fine.

	Energy-Efficient Equipment Types	Equipment Characteristics	
	(Please describe the equipment as specifically as possible.) (1)	Quantity (1)	Project Cost ($) (2)
Equipment Type 1 (1)			
Equipment Type 2 (if applicable) (2)			
Equipment Type 3 (if applicable) (3)			
Equipment Type 4 (if applicable) (4)			

IS5. Now, please think only about the additional energy efficiency equipment not installed through the program (which received no incentives). Would you estimate the energy savings from these additional non-incentivized equipment to be less than, similar to, or more than the energy savings from the SBES program equipment?

Less than the SBES project 1

Similar to the savings from the SBES project 2

More than the SBES project 3

Don't know 4

IS6. Why didn't you apply for a program incentive for the additional energy efficiency equipment?

_____**[OPEN END]**

Outside Spillover

This next set of questions asks about any **non-incentivized energy efficiency equipment** you may have installed at **other** locations within the Duke Energy service territory.

OS1. Did your experience with the program in any way influence you to incorporate energy efficiency equipment at other facilities that did not receive program rebates yet are also served by DUKE ENERGY? Do not include projects that participated in any DUKE ENERGY program.

Yes 1

No 2

Don't know 3

[IF OS1 = 1, CONTINUE, OTHERWISE, SKIP TO BB1.]

OS1a. About how many other facilities were influenced that did not participate in the program? (USE 98 FOR DON'T KNOW.)

___

INSERT NUMBER OF FACILITIES **[RECORD 1-100]**

OS2. Please briefly describe how the program has influenced your decisions to incorporate additional high-efficiency equipment at other facilities that did not participate in the program.

_____**[OPEN END]**

OS3. On a scale of 0 to 10, where 0 is "Not at all important" and 10 is "Extremely important," how important was your participation in the program in your decision to install additional energy efficiency equipment at other facilities

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

[IF OS3 > 5, CONTINUE. OTHERWISE, SKIP TO BB1]

OS4. What type of energy-efficient equipment did you install without program incentives, and what were the approximate quantities and project costs? Estimates are fine.

	Energy-Efficient Equipment Types	Equipment Characteristics	
	(Please describe the equipment as specifically as possible.) (1)	Quantity (1)	Project Cost ($) (2)
Equipment Type 1 (1)			
Equipment Type 2 (if applicable) (2)			
Equipment Type 3 (if applicable) (3)			
Equipment Type 4 (if applicable) (4)			

OS5. On average, would you estimate the energy savings from these other non-program facilities to be less than, similar to or more than the energy savings from the energy efficiency equipment installed through the program?

Less than the SBES project 1

Similar to savings from the SBES project 2

More than the SBES project 3

Don't know ..4

OS6. Why didn't you apply for a program incentive for the additional energy efficiency equipment?

_____**[OPEN END]**

Benefits and Barriers

Before wrapping up, we have a few more questions related to participation and satisfaction.

BB1. Did you experience any problems, delays or difficulties with the program, and if so what were they? (OPEN ENDED – CODED IN ANALYSIS)

The process took too long 1

Too many delays between steps in the process 2

The process was too complex 3

The application materials were difficult to understand 4

Lack of coordination and communication among program staff 5

Did not know who to contact with questions 6

The program staff was not responsive/unable to get needed information or status updates 7

The program staff was not knowledgeable 8

The incentives were less than I expected 9

I do not like the equipment installed 10

I was not given a choice on the specific equipment installed 11

The installation process was disruptive 12

Things were damaged during the installation13

The post-installation clean-up took too long 14

The equipment failed/required repairs/did not work well 15

The equipment installed was sized incorrectly 16

Energy savings were not as significant as expected 17

I don't know where to buy replacement bulbs 18

Other (Please specify) 19

Don't know 20

No problems experienced **[EXCLUSIVE]** 22

[Ask if BB1<> 21]

BB1a. How easy or difficult was it to resolve the problem(s) that you experienced? Please rate on a scale of 0 to 10 in which 0 means very difficult and 10 means very easy.

Very difficult (0)	1	2	3	4	5	6	7	8	9	Very easy (10)	Don't know	Problems were not resolved

BB2. If you could change anything about the entire program process, from the audit to signoff to payment, what would you change?

_____**[OPEN END]**

BB3. On a scale of 0 to 10, with 0 being "Not at all satisfied" and 10 being "Extremely satisfied", how satisfied would you say you are with …? **[MATRIX STYLE QUESTION; RANDOMIZE a-e]**

Items	Not at all satisfied (0)	1	2	3	4	5	6	7	8	9	Completely satisfied (10)	Don't know
BB3a. The energy efficiency equipment installed through the program												
BB3b. The energy savings resulting from the new equipment												
BB3c. **[If lighting]** The quality of the light produced by the new light fixtures/bulbs												
BB3d. Program communications												
BB3e. The amount of the rebate												
BB3f. The overall program experience												
BB3g. Duke Energy												

[IF ANY RESPONSE TO BB3a-g < 5, CONTINUE. OTHERWISE, SKIP TO BB4]

BB3h. Why did you rate [BB3a-BB3g] as you did?

_____**[OPEN END]**

BB4. How did participation in the Small Business Energy Saver program affect your attitude toward Duke Energy? Relative to before the program, is your attitude toward Duke Energy?

..... Much more positive 1

Somewhat more positive 2

About the same 3

Somewhat more negative, or 4

Much more negative 5

Other (Please specify) 6

Don't know 7

BB5. On a scale of 0 to 10, with 0 being "Not at all likely and 10 being "Extremely likely", given the chance, how likely would you be to participate in this or a similar program again?

Not at all likely										Extremely likely	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

[IF BB4 < 7, ASK BB5a. OTHERWISE, SKIP TO BB6]

BB5a. What—if anything—would persuade you to definitely participate in the program again?
_____**[OPEN END]**

BB7. Have you recommended the program to other businesses?
Yes; how many? [ENTER NUMBER] 1

No 2

Don't know 3

BB8. What do you see as the main benefits to participating in the Small Business Energy Saver program? (OPEN ENDED – CODED IN ANALYSIS)
Energy savings 1

Utility bill savings 2

Lower maintenance costs/less frequent light bulb replacements 3

Better quality/new equipment 4

Incentive/rebate 5

Good for the environment 6

Improved safety/morale 7

Set example/industry leader 8

Able to make improvements sooner 9

Other (Please specify) 10

Don't know 11

Feedback and Recommendations

FR1. Do you have any suggestions on how the Small Business Energy Saver program could be improved? (RANK IN ORDER BY IMPORTANCE FOR YOUR ORGANIZATION) (OPEN ENDED – CODED IN ANALYSIS.)

Higher incentives 1

More equipment 2

Greater publicity 3

Better communication/improve program information 4

Contact/information from account executives 5

Longer time period to complete project 6

Better review of applications 7

Simplify application process 8

Electronic applications 9

More funds for the program 10

Other (Please specify) 11

No recommendations **[EXCLUSIVE]** 12

Don't know 13

FR2. Did the equipment offered through the program allow you to upgrade all of the energy efficiency equipment you wanted at the time?

Yes 1 **[SKIP TO FG1]**

No 2

Don't know 3 **[SKIP TO FG1]**

[IF FR2 < 7, ASK FR2a. OTHERWISE, SKIP TO BB6]

FR2a. What other energy efficiency equipment did you want to upgrade?

_____**[OPEN END]**

Firmographics

Finally, I'd like to ask you a few general questions about your company, specifically the facility at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**.

FG1. Does your organization own or lease the space located at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**?

Own 1

Lease 2

Own part and lease part 3

Don't know 4

FG2. Who in your company makes decisions about how energy is managed at this facility?
I DO (describe role) **[OPEN END]**…… ……14

Proprietor/Owner 1
President/CEO 2
Facilities Manager 3
Building/Store Manager 4
Energy Manager 5
Facilities Management/Maintenance Position 6
Chief Financial Officer 7
Other Financial/Administrative Position 8
Sales Staff 9
Lessor 10
Other (Please specify) 11
Don't know 12

FG3. What is the principal activity or type of business that is conducted at this location? This may not be the main activity of your organization, but should be the main activity that occurs at this location. For example, is it an office, a warehouse, a store?
Office 1
Retail (non-food) 2
School 3
Grocery Store 4
Convenience Store 5
Restaurant 6
Health Care/Hospital 7
Hotel or Motel 8
Warehouse 9
Personal Service 10
Community Service/Church/Temple/Municipality..... 11
Industrial Electronic & Machinery..... 12
Other Industrial 13
Agricultural 14
Condo Association/Apartment Management..... 15
Other (Please specify)..... 16
Don't know 17

FG 4. Please enter your preferred email address so that we can send you your $10 e-gift card through TangoCard Rewards Genius. You can select from a variety of retailers or donate your incentive to charity. Please allow 4-6 weeks to receive the incentive email.

- ○ Email address: (1) _____
- ○ No thanks - I do not wish to receive the e-gift card incentive (2)

Closing

Those are all of the questions we have for you. Your responses are very important to Duke Energy and will help as we design future energy efficiency programs. Thank you for participating in this survey!